

28 JUN REC'D

A McGRAW-HILL PUBLICATION

Electronics

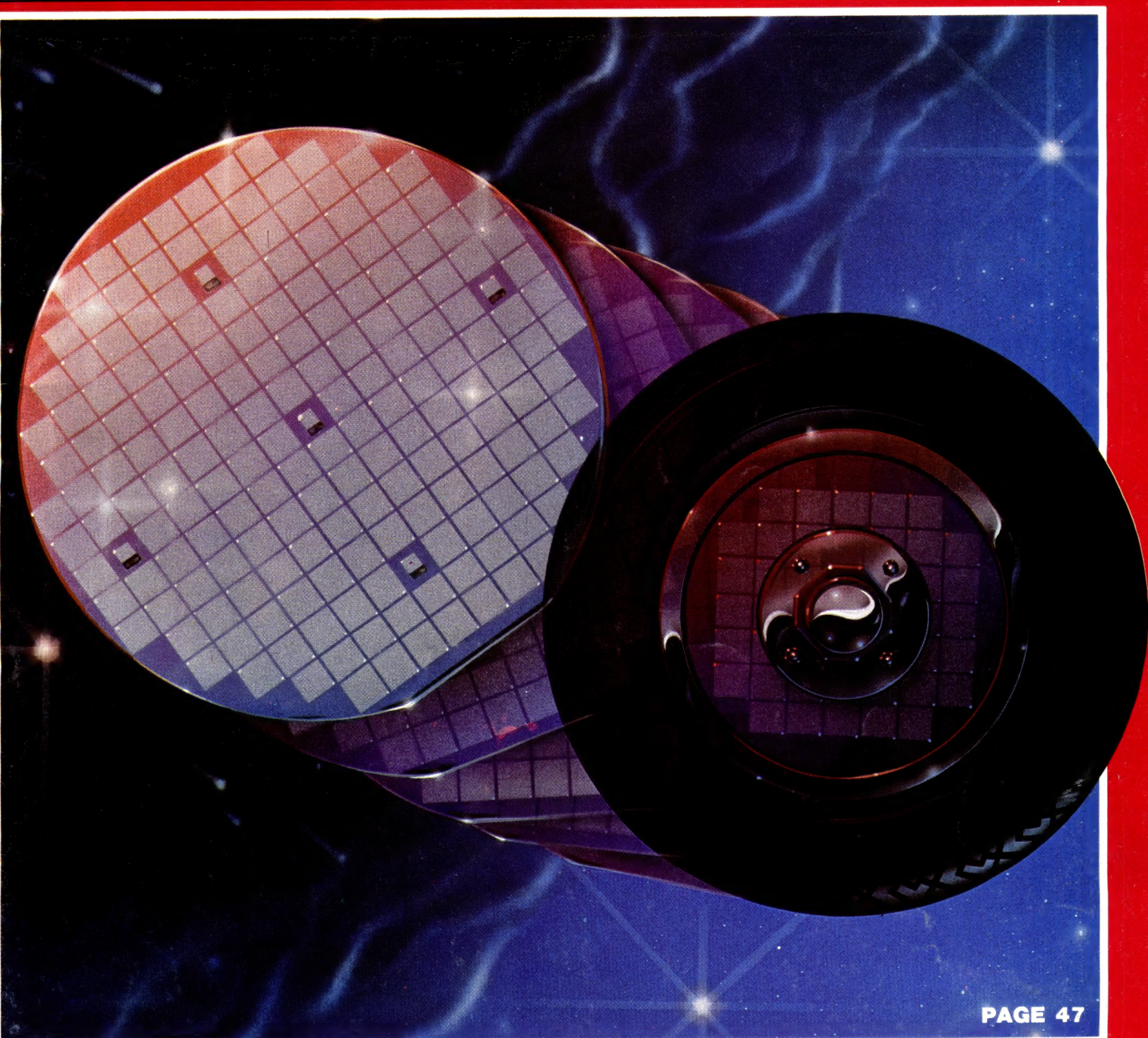
THE WORLDWIDE TECHNOLOGY WEEKLY

THREE DOLLARS

JUNE 17, 1985

AUTO ELECTRONICS

HOW FAR, HOW FAST?



PAGE 47

VECTOR PROCESSORS FIND WIDE SUPERMINI NICHE/31
EUROPEAN CHIP MAKERS WONDER IF THEY'LL SURVIVE/33

THE GRADUATE



Meet Two New Graduates: The Enhanced DASH-2™ Schematic Designer And Our DASH-CADAT™ Logic Simulator.

DASH-2: Our Enhanced Schematic Designer

Now DASH-2 makes you even more productive at schematic design and documentation with new software enhancements.

Our DASH-2 "Graduate" gives you:

- Tag and Drag • Real Time Rubber Banding • Snap To Closest Pin • Area Definition Using The Mouse • Auto Pan • Multi-Level Zoom • Window Defined Save • On-Line Help Screen • On-Line Parts Selection, and • Execute DOS Commands.

Our DASH translators interface with virtually all CAD systems, giving you a growth path to your present and future CAE tools. And DASH-2 hierarchical STRIDES option allows you to handle

complex problems and VLSI designs with ease.

DASH-CADAT: Our New Logic Simulator

DASH-CADAT is the first high performance logic simulator to operate with the IBM XT or AT. It does as much as most mainframe simulators at just 1/10th the cost.

With DASH-CADAT, you can verify the performance of complex logic designs of up to 10,000 gates right at your desk. With DASH's communications link to mainframes, designs of nearly any size can be simulated.

Our extensive library of 100 primitives gets you started quickly for both VLSI and PCB designs. Our optional

concurrent DASH-FAULTSIM permits you to verify test vectors and analyze fault coverage.

Our Graduates Work Cheap

DASH-2 is only about \$6,000 (U.S. price). Complete systems including the IBM computer and printer cost less than \$10,000. If you already own a DASH-1, you can update it to DASH-2 in the field for next to nothing. DASH-CADAT is priced under \$10,000, with DASH-FAULTSIM an affordable \$5,000 option, mere fractions of mainframe simulator prices. If you're designing schematics or VLSI, you should let our graduates help. Phone or write for the whole DASH story.

Productivity of the Future... today.

FutureNet, DASH and STRIDES are trademarks of FutureNet Corporation. IBM is a registered trademark of the IBM Corporation. CADAT is a trademark of HNB Softron, Inc. DASH CAD Translators (Partial List): APPLICON, CADAM, CADAT, CALAY, CBDS, COMPUTERVISION, GERBER, RACAL-REDAC, SCICARDS, TEGAS.

FutureNet®

FutureNet Corporation • 6709 Independence Avenue
Canoga Park, CA 91303 • TWX: 910-494-2681

(818) 700-0691

A subsidiary of DATA I/O Corporation

Authorized **IBM®** Value-Added Dealer

Rent or Lease from:
United States Instrument Rentals, Inc.

Circle 900 on reader service card

SURPRISE!

Now a second source is your first choice for smart alphanumeric displays.

If you've been buying smart alphanumeric displays from Litronix, then here's great news. Now you can get a smart display from a second source—Hewlett-Packard. And your first HP display is free just for sending us your old Litronix part.

But a free display is only part of the story—HP's alphanumerics are a better buy. First, our displays have several product advantages; and second, they're backed by our world-wide sales force and complete technical support.

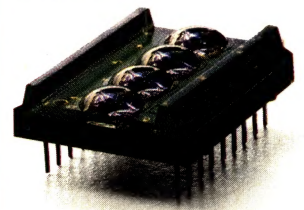
Ours are compatible with theirs—and better.

HP's new four-character HPDL-2416 Alphanumeric Displays are pin-for-pin compatible with the other guy's. So you don't have to redesign anything. But there are some notable differences that we know you'll like. For example, HP offers:

- A faster IC access time making it directly compatible with your microprocessor.
- Better ESD protection, featuring larger buffer diodes for better protection.



For pricing and delivery, contact your local Hewlett-Packard authorized components distributor. In the U.S., call Hall-Mark, Hamilton/Avnet, or Schweber. In Canada, call Hamilton/Avnet or Zentronics, Ltd. For more information, call your local HP sales office listed in the telephone directory white pages and ask for the Components Department.



- Wave solderability for faster and lower cost assembly.
- Industry standard TTL compatibility of 2.0 volts.
- A wider operating temperature range, -20C degrees to +70C degrees.

Let us prove our claims by making HP your first choice for smart alphanumeric displays. So trade in and trade up. Send us one of your old Litronix displays and we'll send you one of ours.

Yes! I want to trade in and trade up.

Yes, please send me a free HPDL-2416 smart alphanumeric display. Enclosed is my old Litronix part.

In the U.S. mail coupon to: Hewlett-Packard Company, 450 West Trimble Road, San Jose, CA 95131. In Europe: Hewlett-Packard, Nederland BV, Central Mailing Department, P.O. Box 529, 1180 AM Amstelveen, The Netherlands.

Name _____
Company _____
Address _____
City _____ State _____
Zip _____ Phone _____
My application is _____

EW

6/17/85

HP: The right choices for smart alphanumeric displays.



**HEWLETT
PACKARD**

EDITOR IN CHIEF: Robert W. Henkel

EXECUTIVE EDITOR, *technical*: Samuel Weber

EXECUTIVE EDITOR, *news*: Arthur Erikson

MANAGING EDITOR: Howard Wolff

SENIOR EDITORS: Tom Manuel,
Kevin Smith, Jeremy Young

ART DIRECTOR: Fred Sklenar

DEPARTMENTS

Business: Robert J. Kozma

Communications: Robert Rosenberg

Computers & Peripherals: Tom Manuel

Government/Military: Karen Berney

Industrial & Consumer: David M. Weber

New Products: Steve Zollo,

Tobias Naegele

Packaging & Production: Jerry Lyman

Semiconductors: Samuel Weber

Software & Microsystems:

Alexander Wolfe

Test & Measurement: Michael B. Rand

NEWS EDITORS

John F. King, Robert J. Kozma,

Jesse J. Leaf, David M. Weber

EDITORIAL PRODUCTION

Charles D. Ciatto, *Manager*, June Noto,

Jody LoGrasso

COPY DESK

Jay J. Iorio, Bill McIlvaine, Jim Taibi,

Sherrie Van Tyle

ART DEPARTMENT

Sachiko Soskin, *Associate Director*

Annamaria Palma, *Art Assistant*

NEWS BUREAUS

Boston: Craig D. Rose

Chicago: Wesley R. Iversen

Dallas: J. Robert Lineback

Los Angeles: Larry Waller

New York: George Leopold

Palo Alto: Clifford Barney, Eve Bennett,

Denise Caruso

Washington: Karen Berney

Frankfurt: John Gosch

London: Kevin Smith

Paris: Robert T. Gallagher

Tokyo: Charles L. Cohen, Michael Berger

ADMINISTRATIVE ASSISTANT: Kathleen Morgan

EDITORIAL ASSISTANT: Ann Jacobs

EDITORIAL SECRETARIES: Laura Aspery

Ina Gruber, Josephine Ortiz

PUBLISHER: Laurence Altman

BUSINESS MANAGER/CONTROLLER:

Frederick J. Kostbar

MARKETING SERVICES DIRECTOR:

Archie A. Anderson

CIRCULATION MANAGER: Leon Irgang

PRODUCTION DIRECTOR: Thomas Egan

SALES ADMINISTRATOR: Susan A. Pienkos

Electronics is back. With this issue, we return to the name, *Electronics*, that named the industry. With this move, we signal more clearly than ever our intention to build on the 55-year-old tradition of accuracy, authority, and comprehensiveness that established *Electronics* as the most respected source of technology information in the world, while responding in new and meaningful ways to the rapid and dramatic changes now taking place in the information needs of our audience.

We are a publication that is more responsive to reader needs. We provide more timely, accurate information with the depth and detail that enable the reader to assess the impact of new developments and make decisions in a timeframe demanded by a volatile industry. In these times, where the wrong technological and market decisions can be fatal to companies and individuals, that volatility calls for a weekly information source that can always be relied on for accurate, authoritative, and worldwide reportage and analysis. That is what *Electronics* has been providing for more than half a century, but now it is in a format that can respond quickly to the rapid changes taking place in our marketplace—changes that affect the way design, development, production, and marketing are done.

While the format and frequency has changed, the tradition of excellence has never been abandoned, nor will it be. And that's why we're restoring the name of our magazine to *Electronics*—to make sure that all our readers understand that our commitment to that tradi-

tion remains unaltered. The evidence of that commitment is manifest in the largest editorial staff of any publication in our field, including some of the most experienced and respected technical journalists in the business, a worldwide network of 10 full-time news bureaus, a support staff dedicated to accuracy and clarity in writing and the best possible graphics, all backed up by the considerable resources of McGraw-Hill.

Yes, *Electronics* is back, and more of it, more often. But the truth is, it never really was away.

One example of the kind of perceptive reporting and analysis we're committed to is provided in this issue by the team of Dave Weber, whose beat is consumer and industrial electronics, and Wes Iversen, our Chicago bureau manager. Turned loose at the just-held Consumer Electronics Show in Chicago, they came up with perceptive technology stories on two subjects dear to the hearts of consumers—TV and FM stereo. In his Probing the News story (p. 35), Weber points out that despite the available technology, viewer apathy and market uncertainty are cooling off the interest in high-definition TV broadcasting. But he also learned that the technology is spilling over into improvements that consumers do want now. For his part, Iversen discloses that new technology may be bringing FM stereo broadcasting its first performance upgrade in almost 25 years (p. 18). These exclusive reports represent the kind of incisive technology reporting and analysis that only *Electronics* can provide.



June 17, 1985 Volume 58, Number 24

98,871 copies of this issue printed

Electronics (ISSN 0893-4989) Published weekly by McGraw-Hill Inc. Founder: James H. McGraw 1860-1948. Publication office: 1221 Avenue of the Americas, N.Y., N.Y. 10020; second class postage paid at New York, New York and additional mailing offices. Postage paid at Montreal, P.Q. Registration Number 9034.

Executive, editorial, circulation, and advertising addresses: *Electronics*, McGraw-Hill Building, 1221 Avenue of the Americas, New York, N.Y. 10020. Telephone (212) 512-2000. Teletype 12-7950 TWX 710-581-4879. Cable address: MCGRAWHILLNEWYORK.

Subscriptions limited to professional persons with active responsibility in electronics technology. No subscriptions accepted without complete identification of subscriber name, title or job function, company or organization, and product manufactured or services performed. Based on information supplied, the publisher reserves the right to reject nonqualified requests. Subscription rates: the United States and possessions \$32 one year, \$55 two years, \$76 three years; company addressed and company libraries \$40 one year, \$67 two years, \$93 three years; Canada and Mexico \$34 one year, \$57 two years, \$78 three years; Europe \$50 one year, \$85 two years, \$125 three years; Japan, Israel, and Brazil \$85 one year, \$140 two years, \$200 three years; Australia and New Zealand \$95 one year, \$170 two years, \$240 three years, including air freight; all other countries \$50 one year, \$85 two years, \$125 three years. Limited quota of subscriptions available at higher-than-basic rate for persons allied to field served. Check with publisher for these rates. Single copies: \$3.00. Please allow four to eight weeks for shipment.

Officers of McGraw-Hill Information Systems Company: President: Richard B. Miller; Executive Vice Presidents: Frederick P. Jannot, Construction Information Group; Russell C. White, Computers and Communications Information Group; J. Thomas Ryan, Marketing and International. Senior Vice Presidents: Francis A. Shinal, Controller; Robert C. Violette, Manufacturing and Technology. Senior Vice Presidents and Publishers: Harry L.

Brown, Computers and Communications; David J. McGrath, Construction. Group Vice President: Peter B. McCuen, Communications. Vice Presidents: Fred O. Jensen, Planning and Development; Margaret L. Dagner, Human Resources.

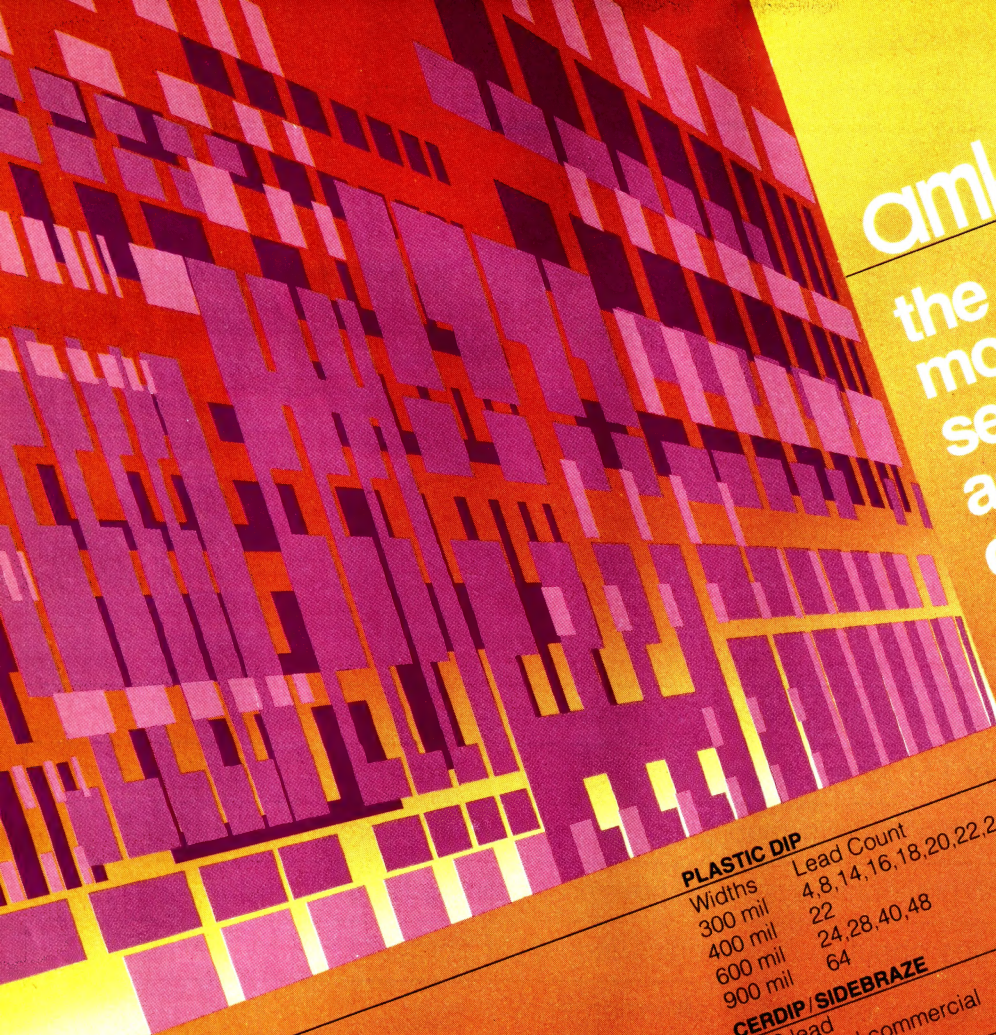
Officers of the Corporation: Harold W. McGraw Jr., Chairman; Joseph L. Dionne, President and Chief Executive Officer; Robert N. Landes, Executive Vice President and Secretary; Ralph J. Webb, Vice President and Treasurer; Donald L. Fruehling, Executive Vice President, Publishing Operations Group; Ralph R. Schulz, Senior Vice President, Editorial; Walter D. Serwatka, Senior Vice President, Manufacturing and Circulation Services. Vice Presidents: Shel F. Asen, Manufacturing; George R. Eisinger, Circulation.

Title registered in U.S. Patent Office; Copyright 1985 by McGraw-Hill Inc. All rights reserved. The contents of this publication may not be reproduced in whole or in part without the consent of copyright owner.

Where necessary, permission is granted by the copyright owner for libraries and others registered with the Copyright Clearance Center (CCC), 21 Congress Street, Salem, Mass. 01970, to photocopy any article herein for the base fee of \$0.50 per copy of the article plus \$0.25 per page. Payment should be sent directly to the CCC. Copying done for other than personal or internal reference use without the express permission of McGraw-Hill is prohibited. Requests for special permission or bulk orders should be addressed to the publisher. ISSN 0893-4989/85 \$0.50 + .25.

Subscribers: The publisher, upon written request to our New York office from any subscriber, agrees to refund that part of the subscription price applying to copies not yet mailed. Please send change-of-address notices or complaints to Fulfillment Manager; subscription orders to Circulation Manager. *Electronics*, at address below. Change-of-address notices should provide old as well as new address, including zip codes. Attach address label from recent issue. Allow one month for change to become effective. Subscriber Service: call (201) 356-7980, 9 a.m. to 4 p.m. EST. Postmaster: Please send Address Changes to Fulfillment Manager, *Electronics*, CN 808, Martinsville, N.J. 08836.

Editorial department phones: Administration (212) 512-2645, News and New Products (212) 512-2685, Technology (212) 512-2666. Bureaus: Boston (617) 262-1160, Chicago (312) 751-3811, Dallas (214) 458-2400, Los Angeles (213) 480-5234, New York (212) 512-2975, San Francisco/Palo Alto (415) 968-2712, Washington (202) 463-1650, Frankfurt 72-5566, London 493-1451, Paris 720-2070, Tokyo 581-9816. **Business departments:** (212) 512-3469 (Business departments follow the Advertisers' Index).



amkor/anam

the world's
most complete
semiconductor
assembly
capability!

PLASTIC DIP

Widths	Lead Count
300 mil	4, 8, 14, 16, 18, 20, 22, 24
400 mil	22
600 mil	24, 28, 40, 48
900 mil	64

CERDIP/SIDEBRAZE

8-48 lead
military and commercial

PIN GRID ARRAY

OPTOELECTRONICS

METAL CAN

TO-220 3/5 LD

PLASTIC SURFACE MOUNT	20, 28, 44, 52, 68, 84 ld
PLCC QUAD	18, 18 long, 22, 32 ld
PLCC RECT	8, 14, 16 ld
SOIC (150 mil)	8, 14, 16 ld
SOIC (300 mil)	16, 18, 20, 24, 28 ld
SOIC (400 mil)	24, 28 ld

CERAMIC SURFACE MOUNT

Sidebrazed chip carriers
Low cost glass seal

Amkor/Anam® is the full service
supplier. We would welcome the
opportunity to discuss your
semiconductor assembly needs.
Please contact us today.

Amkor Electronics, Inc.
1221 River Bend Drive
Suite 240
Dallas, TX 75247
(214) 630-8686

® Registered trademark

amkor
anam

Excellence
in semiconductor
assembly

TORONTO

Circle 3 on reader service card

Electronics

Technology Around the World

Broadcasting CBS and the NAB devise a compandor system to reduce noise and expand coverage of FM stereo broadcasts **18**

Factory Automation Chip makers map plans for factory-net boards **19**

Image Processing TV/photoprint systems show no scanning lines **20**

Military Air Force worries about the electronics industry's ability to meet a surge in production demand in an emergency **21**

Communications Scanner sends color photos instantaneously **22**

Robots Giants of the consumer electronics industry such as Sony, Toshiba, NEC, and Telefunken move into U.S. industrial-robot market **23**

Semiconductors Motorola seeks lead in power MOS FET market **24**

Computer-Aided Engineering Augat Inc. develops a software package that gives pc-board designers the equivalent of a silicon foundry **28**

Probing the News

Computers Mini-supercomputers are filling a niche between superminis and Cray-type supercomputers. Referred to as "Crayettes," they offer nearly the power of a big machine for a lot less money **31**

Semiconductors Has the end come for European chip makers? Their share of the world chip market has fallen to a record low, but they are forced to gamble and invest in a future that might never come **33**

Consumer Electronics Consumers call the tune on high-definition TV.

The technology is ready, but broadcasters must make a commitment **35** (continued on p. 6)

TEST PROGRAMS AND FIXTURES IN HOURS

IT'S TRUE!

At Olivetti Tecnost we have combined our pioneering approach to re-useable fixturing with sophisticated hardware and software to bring you the new PST 100.

PST 100 is a Pre-Screening test system that uses the in-circuit test technique, integrated with revolutionary concepts of autolearning, and progressive programming for upgrading test sophistication.

With an attractive entry price, built-in expansion capability and on-going costs one tenth those of the more traditional systems on the market, the PST 100 sets the standard in price performance that others can only follow.

Find it hard to believe? A simple demonstration will prove it. Request one at the Olivetti Tecnost office nearest you.

TECNOST Ltd CHILTEE MANOR CHASE,
HASLEMERE ROAD LIPHOOK - HAMPSHIRE
TEL. (0428) 722844 -
TELEX 858926 TECNOS G

- Belgium (02) 6738100
- France (3) 0558300
- Israel (03) 706990
- South Africa (011) 3394211

- Sweden (0760) 93085
- Spain 0034 (1) 4423900
- West Germany (089) 919011-13
- India, Bombay 483431

EASY TO
PROGRAMME

AUTOMATIC
GUARDING

REUSABLE
FIXTURES

SIMPLE
EDITING



olivetti tecnost

OLIVETTI TECNOST
Via Gabriel, 69
10015 Ivrea (Torino)
Tel. (0125) 424174-424154
525 ext. 5391/8
Telex 210030 OLIVR I

Electronics

Players Waferscale Integration Inc. works to perfect system on a chip **42**

Encore Computer's Gordon Bell challenges minicomputer and mainframe makers.

Rafael Jacoel, picked by workers, turns Italian socket manufacturer around **44**

Special Technology Reports

Automotive Electronics Radar guidance and collision-avoidance systems aren't here yet, but automakers' record in delivering audio, safety, and other systems hints at a solid future for electronics suppliers **47**

Technology Readout: Communications SLIC chip shrinks phone-line interfaces. Advanced Micro Devices' integrated circuit replaces power-hungry hardware and allows more subscriber lines to be placed on each card **54**

New Products

Instruments Sales of digital scopes outpace analog models. A roundup of recent offerings sees new and traditional players packing in more punch **59**

Computer Graphics Board offers fastest pixel rate available for IBM PC **61**

Circuit Simulation System runs 20 to 100 times faster than VAX **62**

Power Supplies 200-W switching supply runs 38,000 hours before failure **63**

Memories 512-K CMOS ROM provides 200-nanosecond access time **64**

Printers Paper-saving dot-matrix printer sells for less than \$300 **64**

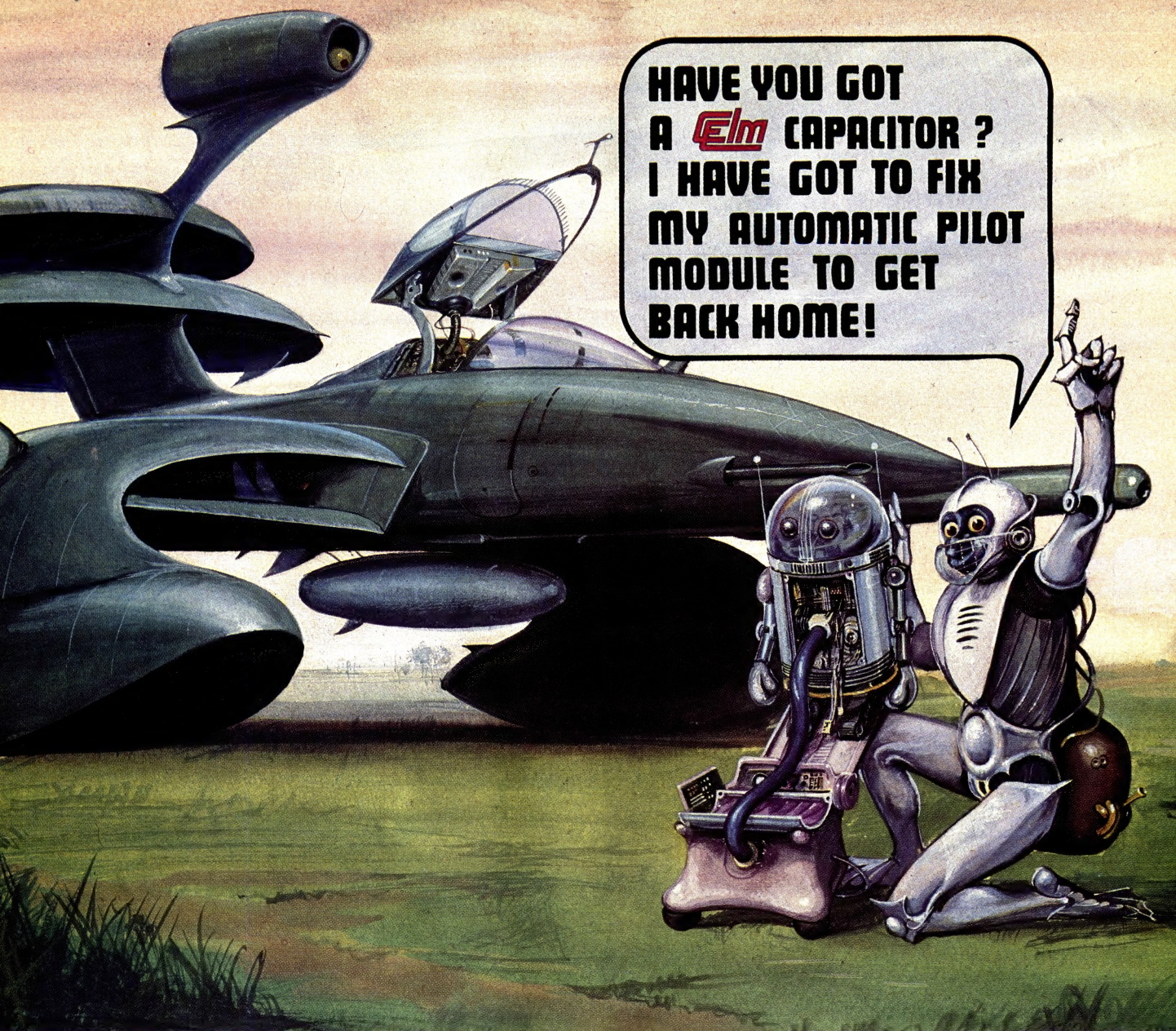
Software Package lets IBM PC develop software for Multibus **66**

Test Systems High-throughput computer-monitored system handles SMDs **68**

Features

Departments Publisher's Letter **2** Meetings **8** Up Front **13** Diary **17** Bottom Lines **43**

Materials **71** Letters **72** Electronics Index **73** Editorial **76**



TANTALUM

High reliability - Low leakage current - Hermetic seal
High capacity-volume ratio

POLYCARBONATE

Very low dissipation factor - Very stable capacity
Tight tolerances (1 and 2%)

POLYSTYRENE

High insulation resistance - Controlled temperature coefficient
Very tight tolerances (0,5 - 2%)

POLYESTER

Long life - Low dissipation factor - Excellent humidity resistance

POLYPROPYLENE

High pulse rise - Stability - Tight tolerances

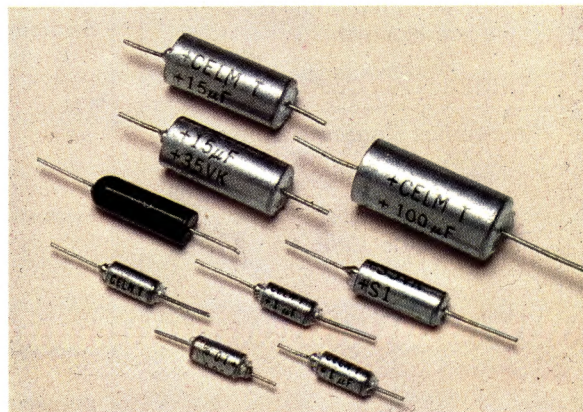
HOMOLOGATIONS

Elm has been homologated and codified as qualified manufacturer of electronic components by the Defence Department and by Italian Electrical Technology Committee.

Tantalum Capacitors have been homologated by Defence Department according to MIL STANDARD 39003 and by CECC SYSTEM according to UTE C 83 112 and BS E 9073 N001.

These capacitors are included in the european QPL list.

Circle 6 on reader service card



STUDIO FABRIS

Elm S.p.A.

80026 CASORIA (NA) - Via Naz.le delle Puglie 177
Tel. 0039-81-7599033 (PBX) - Telex 721592 - ITALY

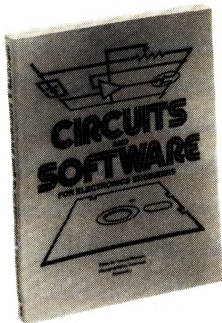


Divisione componenti

20129 MILANO - V.le Regina Giovanna, 8
Tel. 0039 2-206134 (PBX) - Telex 331604 - ITALY

DESIGN PROBLEMS?

**CIRCUITS AND SOFTWARE
FOR
ELECTRONICS ENGINEERS**
focuses strictly
on design problems!



Access stimulating, clever approaches that can speed your creative design concepts.

This indispensable source contains hundreds of circuit schematics, block diagrams and computer programs that are conveniently organized into 25 vital categories by function.

Design appropriate circuitry to meet challenging specifications.

Save time by adapting proven circuits and software to a wide range of applications.

Save money and increase productivity by avoiding costly design errors.

Don't take the chance of being less than on top of the latest circuitry developments.

ORDER YOUR COPY NOW!

Electronics Magazine Books

P.O. Box 541
Hightstown, NJ 08520

or

McGraw-Hill Int'l. Pub. Co.

Attn: ECC
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England

Send me _____ copy (copies) of R370
for \$19.95 each.

- ☐ Payment enclosed
☐ Send proforma invoice

Name _____

Company _____

Street Address _____

City _____ State _____ Zip _____

Allow 4-6 weeks for delivery.

MEETINGS

National Computer Conference, American Federation of Information Processing Societies (1899 Preston White Dr., Reston, Va. 22091), McCormick Place, Chicago, July 15-18.

IBM Futures: The Next Ten Years, Gartner Group Inc. (72 Cummings Pt. Rd., Stamford, Conn. 06904), Westin O'Hare Hotel, Chicago, July 18-19.

International Symposium on Microwave Technology in Industrial Development, Brazilian Microwave Society (Jose Giarola, Telebrás Research & Development Center, 13100 Campinas, São Paulo, Brazil), Telebrás Research & Development Center, São Paulo, Brazil, July 22-25.

Siggraph '85—Twelfth Conference on Computer Graphics and Interactive Techniques, Association for Computing Machinery and IEEE (Siggraph '85, Services Office, 111 E. Wacker Dr., Chicago, Ill. 60601), Moscone Convention Center, San Francisco, July 22-26.

Financial Information Systems—Integrating Personal Computers, National Institute for Management Research (P.O. Box 3727, Santa Monica, Calif. 90403), L'Enfant Plaza Hotel, Washington, July 24-26.

The 1985 Hardened Electronics and Radiation Technology (HEART) Conference, Science Applications Inc. (J.P. Retzler, Science Applications Inc., 501 Marin St., Suite 200, Thousand Oaks, Calif. 91360), Naval Postgraduate School, Monterey, Calif., July 25-26.

Advanced Concepts in High-Speed Semiconductor Devices and Circuits, IEEE (Elma Weaver, 318 Phillips Hall, Cornell University, Ithaca, N.Y. 14853), Statler Auditorium, Cornell University, Ithaca, N.Y., July 29-31.

World Conference on Computers in Education, American Federation of Information Processing Societies *et al.* (AFIPS, 1899 Preston White Dr., Reston, Va. 22091), Scope Convention Center, Norfolk, Va., July 29-Aug. 2

1985 International Computers in Engineering Conference, American Society of Mechanical Engineers (345 E. 47th St., New York, N.Y. 10017), Sheraton-Boston Hotel, Boston, Aug. 4-8.

Semipro-USA, U.S. Department of Commerce (Joseph Burke, Department of Commerce, Science and Electronics, Room 4044, Washington, D.C. 20230), U.S. Trade Center, Seoul, Aug. 5-9.

Fifth National Conference on Artificial Intelligence, American Association for Artificial Intelligence (Lorraine Cooper, AAAI, 445 Burgess Dr., Menlo Park, Calif. 94025), Convention Center, Philadelphia, Aug. 11-15.

Seminars

Applied Instrumentation and Measurements Engineering, Union College (Graduate and Continuing Studies, Wells House, 1 Union Ave., Schenectady, N.Y. 12308-2363), Union College, Schenectady, N.Y., July 15-19.

Data Processing Project Management, American Management Association (P.O. Box 319, Saranac Lake, N.Y. 12983), AMA Management Center, Chicago, July 22-24.

Data Communications, Center for Advanced Professional Education (1820 E. Garry St., Suite 110, Santa Ana, Calif. 92705), Hilton Inn North, Columbus, Ohio, July 24-26.

Transmission Technologies: Optical Fibers, Coax, and Wire, Datapro Research Corp. (1805 Underwood Blvd., Delran, N.J. 08075), Chicago Marriott Downtown, Chicago, July 25-26.

Integrated Services Digital Network, Continuing Education Institute (10889 Wilshire Blvd., Los Angeles, Calif. 90024), Hyatt Regency, Montreal, July 26.

Database/85, University of California at Berkeley (Continuing Education in Engineering, University of California Extension, 2223 Fulton St., Berkeley, Calif. 94720), Berkeley Marina Marriott Hotel, Berkeley, Calif., July 29-Aug. 2.

Microcomputers in Control Systems: Hardware, Software, & Interfacing, George Washington University (Merrill Ann Ferber, Continuing Engineering Education Program, George Washington University, Washington, D.C. 20052), George Washington University, Washington, July 29-Aug. 2.

Computer Vision and Image Processing, University of Michigan (Engineering Summer Conferences, 200 Chrysler Center—North Campus, University of Michigan, Ann Arbor, Mich. 48109), Chrysler Center, University of Michigan, Ann Arbor, July 29-Aug. 2.

Global Positioning System, Continuing Education Institute (10889 Wilshire Blvd., Los Angeles, Calif. 90024), Holiday Inn, Boston, July 29-Aug. 2.

Signal Generator SMPD second to none



Best in its class from 5 kHz to 2.72 GHz

SMPD receives top marks whatever the test, e.g. in CEPT-based measurements on transceivers where it functions as an interference source up to 2.72 GHz, in the development of telemetry and telecommunication systems and in all sorts of general lab applications. Optional high-speed pulse modulation also means the testing of radar receivers under real conditions.

- Frequency range
5 kHz to 2.72 GHz
- Output level -143 to 13 dBm
- Highly linear ϕ M and FM with wide deviations (e.g. max. deviation of 3.2 MHz at carrier frequencies ≥ 1.36 GHz) and precise AM over its entire frequency range
- Pulse modulation with rise and fall times of less than 10 ns and an on/off ratio of 80 dB, also simultaneously with AM and ϕ M/FM
- IEC 625-1 and IEEE 488 remote control
- Spectrally pure signals for measurements on oscillators and out-of-band measurements on transceivers
- Reliable attenuator for system applications with more than 10 million guaranteed operations

The SMPC Signal Generator is the "little brother" of the SMPD with the same specifications up to 1.36 GHz.



Ask for the detailed data sheets **SMPD** and **SMPC**

Rohde & Schwarz GmbH & Co. KG
Postfach 80 14 69
D-8000 Muenchen 80
Federal Republic of Germany
Telex 523 703 (rus d)
Tel. internat. + (49 89) 41 29-0

There are **R & S agencies** in 80 countries. We plan and supply stationary and mobile systems, also on a turn-key basis. **R & S services** comprise installation, maintenance, calibration, training and documentation.



ROHDE & SCHWARZ

INVULNERABLE

Its undisputed mastery within the field of protective components has enabled Thomson Semiconductors to develop and launch the TRISIL - a component of exceptional performance and superior characteristics.

The TRISIL ensures the protection of subscriber sets and all peripheral equipment i.e. modems, tele-printers, etc. against over-voltages of differing origins.

Invulnerable, it can confidently be relied upon to absorb high repetitive transient currents by placing a "crowbar" across the line being protected.

Let Thomson Semiconductors range of TRISIL devices protect your equipment against external dangers, and you in turn will become invulnerable.



THOMSON

SEMICONDUCTORS



France PARIS VELIZY Tel. (3) 946.97.19	Austria WIEN Tel. (222) 94.62.82	Bénélux BRUXELLES Tel. (2) 648.64.85	Brazil SAO PAULO Tel. (5511) 542.47.22	Canada MONTREAL Tel. (514) 288.41.48.	Denmark COPENHAGEN Tel. (01) 83.50.90	Far East Asia HONG KONG Tel. (3) 721.95.82	Finland HELSINKI Tel. (0) 75.04.14
--	--	--	--	---	---	--	--

A NEW HORIZON

*Save a little room
for something tasteful.*

**NEC's FIP displays are the
perfect finishing touch
for your product mix.**

A flat vacuum fluorescent display is a great way to heat up your product sales. Not only are they bright and easy-to-read, they offer a wide viewing angle and unbeatable longevity.

NEC's dot-matrix FIP (Fluorescent Indicator Panel) FM Series makes it easy for you to pull it all together. A compact module couples directly with the data bus of your system and operates on a single 5V power source.

NEC offers 8 different varieties ranging from 20 ch x 1 line to 40 ch x 6 lines, plus a graphic version with 180 x 48 dots. Many fonts are available—ASCII-7, ECMA-7 (General European, German, Scandinavian, Spanish) and JIS. And we also welcome custom designs.

So for your next product mix, leave a little room for something special.

A brilliant FIP from NEC.



Type No.	No. of character	character format	character height x width (mm)	function			
				data write	command write	data read	data input
FM20X1AA-D	20CH x 1L	5 x 7 + cursor	5.05 x 3.55	○	○	○	P
FM20X1DB-A	20CH x 1L	5 x 7	9.0 x 6.3	○	○	○	P
FM20X2AA-C	20CH x 2L	5 x 7	5.05 x 3.55	○	○	○	P
FM40X1AA-B	40CH x 1L	5 x 7 + cursor	5.05 x 3.55	○	○	○	P
FM40X1FB-B	40CH x 1L	5 x 12	8.80 x 3.55	○	○	○	S/P
FM40X2AA-A	40CH x 2L	5 x 7 + cursor	5.35 x 3.55	○	○	○	P
FM40X6AA-A	40CH x 6L	5 x 7 + cursor	5.0 x 3.5	○	○	○	S/P
FM80X2AA-A	80CH x 2L	5 x 7 + cursor	3.5 x 2.05	○	○	○	S/P
FM180GX48BA-A	180 (column) x 48 (row) dots	—	—	○	×	×	P

S: Serial P: Parallel

NEC Electronics Inc.
401 Ellis Street, Mountain View, CA 94043.
Tel: 415-960-6000. TWX: 910-379-6985.

NEC Electronics (Germany) GmbH
Tel: 0211-650302. Telex: 8589960 NEC D.

NEC Electronics (UK) Limited
Tel: 0698-732-221. Telex: 777565 NEC UKG.

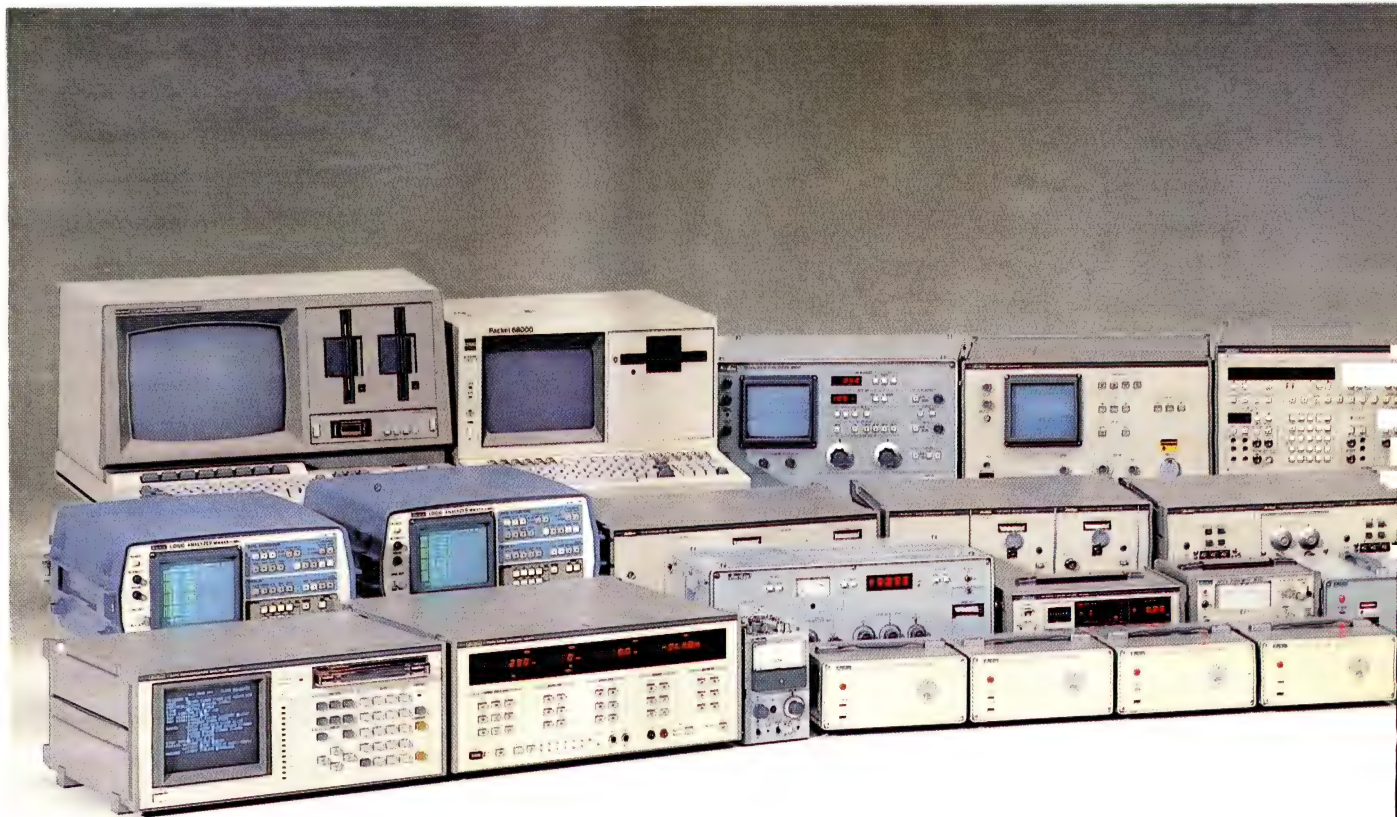
NEC Electronics (France) S.A.
Tel: 1-609-9004. Telex: 203544 NEC EF F.

NEC Electronics Italiana S.R.L.
Tel: 02-630368. Telex: 315355 NEC EIT I.

NEC Hong Kong Limited
Tel: 0-242-824/7. Telex: 84561 HK NEC HX.
Taipei Branch: Tel: 02-522-4192, 522-4258.
Telex: 22372 HK NEC TP.

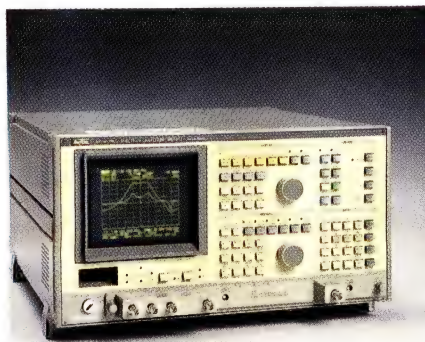
NEC Singapore Pte. Ltd.
Tel: 4819881. Telex: NEC SIN RS 39726.

Better Instruments for Better Communications



MS560J Network/Spectrum Analyzer

With a frequency range from 100Hz all the way up to 300MHz this versatile performer is actually a network, spectrum and impedance analyzer all in one. Now just one instrument is all you need to measure transmission characteristics, impedance, spurious emissions, noise, compression/expansion characteristics — and lots more. It's another superior instrument from Anritsu.



Anritsu means communications.

We began building telephone and radio equipment more than 50 years ago. And although we've expanded into other fields since then, we've remained true to those first electronic roots.

In fact, the Anritsu name is now known around the world as synonymous with communications. From public telephones to sophisticated, state-of-the-art



optical and digital transmission systems, Anritsu communications products are highly regarded for both unequalled reliability and technical excellence.

With such wide-ranging experience in all phases of communications, it's no surprise that our electronic measuring instruments are superior, too.

Anritsu builds the electronic instruments that keep electronic

and fiber optic communications operating at the knife edge of efficiency. From the simple measurement of voltage and current to complete high-level analysis of both analog and digital circuitry, Anritsu instruments are built by experts in communications. And Anritsu instruments are built to be used.

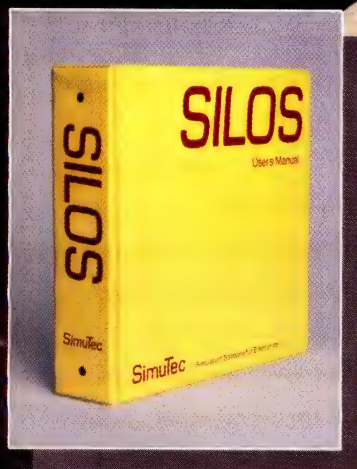
Whether it's an Anritsu electronic voltmeter, a network ana-

lyzer or a complete GPIB-based automatic test system, you'll find a basic field-proven ruggedness built in. And you'll find controls that actually make sophisticated measurements simpler to perform.

At Anritsu, we're striving toward still better instruments. And better communications.

ANRITSU ELETRÔNICA S. A.
Av. Passos, 91-Sobrelôjas 204/205-Centro, 20.051-Rio de Janeiro-RJ, Brasil Phone: 221-6086, 224-9448 Telex: 2131704 ANBR
ANRITSU AMERICA, INC.
128 Bauer Drive, Oakland, NJ 07436, U.S.A. Phone: 201 337-1111 Telex: 642-141 ANRITSU OKLD
ANRITSU EUROPE LIMITED
Thistle Road, Windmill Trading Estate, Luton, Beds, LU1 3XJ, U.K. Phone: (STD0582)418853 Telex: 826750 ANRSEU G
ANRITSU ELEKTRONIK GmbH
Uhlandstrasse 9, 4000 Düsseldorf 1, F.R. Germany Phone: (0211)682424 Telex: 8584904

Anritsu
ANRITSU ELECTRIC CO., LTD.
10-27, Minamiazabu 5 chome, Minato-ku, Tokyo 106, Japan
Phone (03) 446-1111/Telex: 0-242-2353
Cable: ANRITDENKI TOKYO



"The right tool for the right job."

How many times have you heard that phrase? Yet time and time again we see transistor level MOS/VLSI engineers using such unsophisticated tools that it's a wonder they can design a working chip at all. Everyone knows that an engineer will produce better designs in less time given the right tools.

That's what SILOS™, SimuTec's Logic Simulator, will give you; the right tool for MOS/VLSI design.

WE GIVE YOU REAL WORLD MODELING.

When it comes right down to it, the most efficient model is one that looks and acts like the real world—the actual circuit. Since you design with real phys-

ical devices, you want a simulator that can model those accurately. SILOS allows you to accurately combine transistor-level devices and high-level functions in the same simulation.

WE GIVE YOU MEANINGFUL FEATURES.

Features are important only if they allow you to model the real world in a flexible and useable way.

Some simulators give you a lot of features because they need to disguise their inability to model reality. SILOS gives you the features you need to get your job done accurately and reliably with a model that looks and acts like your design.

WE GIVE YOU SERVICE.

We can't promise an instant

solution to your problems. But we can promise that we'll address your needs within 4 hours of your call, if not immediately.

We believe that service is not a sometime thing. We believe that helping our customers should be an ongoing service, and we deliver that service before, during and after the sale both directly and through our growing network of OEMs and Distributors.

Our support people include experienced design engineers who understand your needs and can help you with design modeling problems.

WE GIVE YOU EXPERIENCE.

The people at SimuTec started the software simulation revolution more than 15 years

ago and have since developed increasingly mature design tools with programs like: AS-PEC™, LOGIS™ and ILOGS™. Today, we combine that experience in SILOS™.

Equally important is the fact that more established MOS/VLSI design companies have used our products for more years than they've used all of our competitors' products combined.

No other company understands your engineers' real world problems while offering the features, the service and the experience that we can. We stand ready to give you the modeling capabilities you need now and in the years ahead.

SILOS™, SIMUTECH'S LOGIC SIMULATOR.

Turn to us for the right tools to do the tough part of your design.

SILOS™ FEATURES INCLUDE:

POWERFUL MODELING ELEMENTS:

- Models high level functions such as gates, ROMs, RAMs and PLAs as well as lower level primitives like transistors, resistors and capacitors.
- Bidirectional signal propagation, charge decay, charge sharing, zero or finite delays, spike and instability identification.
- Allows addition of user-definable functional block subroutines.

EXPANDED MODELING STATES:

- Our unique 12+4 state concept—three logic "levels" (low, high and unknown), each with four possible "strengths" (supply, driving, resistive and high Z), allowing wired-AND and wired-OR configurations. Added to this is our "Unset" state and three decay states.
- **FAULT SIMULATION:** Enhanced concurrent fault simulation handling both unidirectional and bidirectional circuit

models; full input and output stuck fault simulation using compensated fault collapsing; statistical sampling and controllability reporting.

EASE OF USE:

- Interactive or batch logic and switch level simulation; Simulation history storage and restart capability; Versatile macro definitions with deep nesting capabilities; Automatic verification of the logical consistency of

all the network states prior to time-dependent simulation.

- Logic analyzer type graphics outputs.

COMPATIBILITY:

- SILOS Interfaces to the most advanced complementary packages, such as ECAD™, Mentor Graphics™, Chromatics™, Corydon Technology™, Daisy™ and Silvar-Lisco™. Available for installation on most 32 bit mainframes and most popular workstations.

SimuTec™ Simulation Software for Electronics
920 Incline Way, Bldg. 2
P.O. Box 3400
Incline Village, NV 89450
(702) 831-1399

SimuTec



SEE US AT BOOTH NUMBERS 352 AND 353 AT THE 22ND IEEE/ACM DESIGN AUTOMATION CONFERENCE IN LAS VEGAS, JUNE.

Circle 12 on reader service card

UP FRONT

SIA files trade charges against Japanese electronics companies . . .

The latest salvo in the U.S.-Japan trade war was fired last Friday when the Semiconductor Industry Association filed a complaint with the Office of the U.S. Trade Representative alleging unfair trade practices by the Japanese electronics industry and restrictive Japanese government policies that have limited U.S. chip sales to 10% of the Japanese market. The petition cites Section 301 of the Trade Act of 1974, which was amended in 1984 to add the concept of fair and equitable market access as a basis for a complaint. The Act requires the president to decide within one year whether retaliation is appropriate if no negotiated solution is found. The SIA charges that Japanese firms have relegated U.S. chip makers to the position of "residual suppliers" through their practice of buying primarily from each other. The SIA move follows recent Commerce Department allegations of dumping leveled against Hitachi Ltd. [*ElectronicsWeek*, June 10, 1985, p. 11]. That dispute is also covered in the SIA complaint; the group requests "open negotiations with the Japanese government" to prevent chip dumping in the U.S.

Gary Tooker, general manager of Motorola Inc.'s Semiconductor Products Division and chairman of the SIA, alleges that, "A small number of major Japanese companies dominate their country's market for semiconductors, such as those used in consumer electronics, telecommunications, and industrial products." These major Japanese producer-consumers, which include Hitachi, NEC, Fujitsu, and Toshiba, "are procuring semiconductors primarily from each other rather than on the basis of competitive merit," Tooker says. The SIA is seeking "a prompt and dramatic improvement in U.S. sales in Japan" equal to Japan's share of the U.S. market. The petition notes that although Japan's import policies were liberalized in 1975, U.S. firms fare no better there today than they did before that date. Says the SIA's Washington counsel R. Michael Gadbaw, "Our objective is to sell as much in Japan as Japan sells here." □

. . . as Commerce Department extends Chip Protection Act to Japanese designs

Citing a "good-faith effort" on the part of the Japanese government to complete its own counterpart legislation, the Commerce Department's Office of Patents and Trademarks last week extended protection of Japanese chip designs for one more year under the 1984 Semiconductor Chip Protection Act. Protection could be extended permanently when counterpart legislation is approved by Japan. The decision allows Japanese firms to register with the U.S. Copyright Office products that have been introduced since Nov. 8, 1984, when the U.S. law became effective, and any future designs until June 6, 1986. SIA counsel R. Michael Gadbaw says the industry had favored interim protection for Japanese chip makers lasting only six months, but adds the net effect of the decision is positive. "We can both win," Gadbaw concedes, because U.S. companies are worried about Japan while the Japanese are nervous about Korean inroads into their markets. □

Pessimistic IBM sees lower growth this year

Not even IBM Corp. is immune to the current recession in the electronics industry. In the company's most pessimistic statement concerning its operations this year, president John Akers said the computer giant's performance for the first nine months of this year "will still not be even" with the performance of the first nine months last year. In addition, he said, "If the economy does not come back, we may have to reassess the fourth quarter as well." IBM had been telling the public that it expected "solid growth" in 1985, based on a strong performance in the final three months of this year. The company is now retreating from that forecast. □

UP FRONT

Intel offers development systems for IBM PCs

Intel Corp. has changed its approach to development software and now offers its proprietary development tools for use on IBM Corp.'s Personal Computer and its clones. Intel, inventor of the microprocessor, also invented the development system—a \$20,000 microcomputer for writing, editing, compiling, and debugging code destined for its 80XX line. Users had to buy the development system to program the microprocessors, a practice that became hard to justify when cheaper, general-purpose microcomputers such as IBM's PC came along. The Santa Clara, Calif., company said all of its tools—including a new high-level symbolic debugger for target systems, called Target Scope—will run under PC-DOS and Xenix on the PC/XT and PC AT. □

Toshiba set to ship 18-mips superminicomputer

A superminicomputer developed by Toshiba Corp., with a speed of 18 million instructions per second in a four-processor configuration, should be the fastest machine in its class when deliveries start in Japan this October. Even the new Tosbac G8050's single-processor speed of 5.8 mips is comfortably above the 4.8-mips value of Digital Equipment Corp.'s VAX 8600, the yardstick against which this type of machine is measured. Prices range from \$380,000 for a small system with 4 megabytes of memory to more than \$12 million for the largest configuration. (See related story, page 31.) □

Datapoint's newly named operating chief quits after one month

Troubled Datapoint Corp. in San Antonio, Texas, remains in a state of turmoil with the unexpected departure of chief operating officer John C. Butler. A 25-year veteran of Sperry Corp., Butler joined Datapoint on May 13. His exit was sudden and unexplained by the office-automation vendor. In an interview early this month, Butler had said he was confident that Datapoint would successfully cut its operations by half, refocus product efforts on its current customer base, and soon return to profitability. □

Ridge Computers brings out second-generation RISC machines

Offering its second generation of machines with reduced-instruction-set-computer (RISC) architecture, Ridge Computers last week brought out four new versions of its "compute-station" computers, machines designed to fill the gap between engineering work stations and superminicomputers. The Santa Clara, Calif., firm's new models can be used as stand-alone computers or part of a networked hierarchy of work stations. The products' main improvement is a new central processing unit with 100% to 300% better floating-point-calculation capability. □

Sun Microsystems cuts work-station prices

In response to plummeting memory prices, rising competition in the work-station market, and a softening of its sales, Sun Microsystems of Mountain View, Calif., has slashed prices on memory by 63% and work-station hardware by 23% to 34%. The maker of Unix-based work stations says a 2-megabyte diskless Sun-2/50 costs \$8,900 compared with \$13,400; and the Sun-2/160 Color SunStation with 2 megabytes of memory is now \$27,900, down from \$36,400. "Component costs have come down dramatically," says a company spokesman, who cited lower prices for both memory and microprocessor chips. Also affecting the decision was Digital Equipment Corp.'s announcement of its Microvax II and speculation about IBM Corp.'s entry into the work-station market. □

STOP GETTING YOUR WIRES CROSSED.

One mix up, and a whole project can get thrown off. Which can mean costly delays. With Post-it[™] Notes, you can put important notes or directions right where they'll be seen. The unique, repositionable adhesive means they'll stay put. Then come off as easily as they went on. And the bright

color means your message is sure to get noticed.

Call 1-800-328-1684 for a free sample. Then get more from your office manager, local stationer or art supply dealer.

With Post-it Notes, you'll never have problems making connections.

Post-it[™]
Note Pad



BILL,
DIDN'T UIM TELL
YOU TO CHANGE
THIS WIRING?
SEE ME
IMMEDIATELY!
JOHN

Commercial Office Supply Division 3M. "Post-it" is a registered trademark of 3M.

3M

Circle 15 on reader service card

YOU CAN'T SEE RELIABILITY.



BUT YOU CAN RELY ON SHARP

On the outside, all 4N series photocouplers basically look alike. The difference is inside. With Sharp PC4N photocouplers, that difference is reliability. Every Sharp PC4N incorporates Sharp's sophisticated electronics technology. And each phase of the manufacturing process is carefully monitored under Sharp's strict standards of quality control. This means that Sharp PC4N photocouplers will perform up to specification the first time—every time—you use them.

If reliable performance is important to you, take a look at Sharp's line of PC4N photocouplers. They're high-performance electronic devices with a difference—Sharp reliability. You can count on it.

PC4N-Series

Model No.	Absolute Maximum Ratings			Electrical Characteristics							(Ta = 25°C)	
	Collector-Emitter Voltage V _{CEO} (V)	Isolation Voltage V _{iso} (V _{rms})	CTR (%) MIN.	Current Transfer Ratio		Response Time				Collector Dark Current		V _{CE} (V)
				I _F (mA)	V _{CE} (V)	I _r (μs) TYP.	I _C (mA)	R _L (Ω)	V _{CE} (V)	I _{CEO} (nA) MAX.	V _{CE} (V)	
Single Phototransistor	30	2,500	20	10	10	3	2	100	10	50	100	10
		1,500		10	10							
		1,500		10	10							
		500	10	10	10	3 (t _{on})	2	100	10	50	100	10
		3,550		10	10							
		2,500		10	10							
Darlington Phototransistor	30	1,500	100	10	10	MAX. 5 (t _{on})	50	*200 (mA)	10 (V)	100	100	10
		2,500		10	10							
		1,500	500	10	10							
		2,500		10	10							

*I_w = 1.0ms

SHARP

SHARP CORPORATION, JAPAN

Circle 16 on reader service card

SHARP CORPORATION International Business Group, Electronic Components Sales Dept.
22-22, Nagaike-cho, Abeno-ku, Osaka 545, JAPAN
Tel: (06) 621-1221 Cable: LABOMET OSAKA Telex: J63428 Attn: OSKPA (LABOMET A-B)

U.S.A.: SHARP ELECTRONICS CORPORATION
10 Sharp Plaza, Paramus, New Jersey 07652 Tel: (201) 599-3750
Electronic Components Division

EUROPE: SHARP ELECTRONICS (EUROPE) GMBH
Sonninstrasse 3, 2000 Hamburg 1, F.R. Germany Tel: (040) 23775-286
Electronic Components Dept.

THIS Electronics WEEK

THURSDAY June 6

Control Data Corp. said **Magnetic Peripherals Inc. will close 20 facilities for the first two weeks in July.** Lagging sales were cited as the reason for the shutdowns at MPI, a joint venture of Control Data, Sperry, Honeywell, and France's Bull Group. Over 2,000 employees will be affected, the company said, and it will gradually expand its Government Systems Division "over the next few months" into a plant that MPI now uses to make disk drives. Control Data declined to speculate on how many jobs will be lost during the change.

FRIDAY June 7

Mallory Capacitor Co. announced the permanent shutdown of its plant in Waynesboro, Tenn., but unlike other recent closings, this one is not because of poor business. Rather, the plant, which hasn't operated since July 30, 1984, **will not reopen because of contamination by persistently high levels of polychlorinated biphenyls.** The PCBs were used in the manufacture of the ac paper-oil capacitors built in the facility.

MONDAY June 10

Texas Instruments Inc. said it won a \$462.1 million contract from the Navy to build 1,571 more HARM, or high-speed anti-radar missiles. HARM will be built by TI's Equipment Group in Dallas, which has already delivered 470 of the missiles since production on previously awarded contracts began in 1981. . . . Tandem Computers Inc. introduced five new products for its Information Management Technology line. **Tandem's products are designed to allow customers to share information among a variety of personal computers,** work stations, terminals, facsimile devices, and local-area networks. . . . **Lotus Development Corp. completed its acquisition of Software Arts Inc.** and quickly discontinued its former competitor's most popular product. Visicalc, a spreadsheet package that led the way for the best-selling Lotus 1-2-3. Vendors will be able to exchange their stock for credit toward Lotus products, and owners will be able to trade in the program for Lotus 1-2-3 for \$250, the company said. It is negotiating to sell the marketing rights for Software Arts' TK!Solver, but will provide customer support for Visicalc and TK!Solver for two years.

TUESDAY June 11

Announcing that it has signed contracts valued at nearly \$20 million with the China Electronics Import and Export Corp., **BASF will build two plants in the People's Republic of China**—one for the manufacture of floppy disks, the other for TDI, a polyurethane foam component—in the People's Republic. Chinese workers trained by the company will operate the plants, BASF said. . . . **Burroughs Corp. will close its Coral Springs, Fla., plant,** eliminating about 600 jobs. The company also said it will close its Orlando, Fla., engineering facility, affecting an additional 150 workers, who will be laid off or transferred to a Plymouth, Mich., plant between July 1 and Oct. 31.

WEDNESDAY June 12

The Semiconductor Industry Association said **May shipments by U.S., European, and Japanese semiconductor makers were up,** but orders declined. U.S. market shipments rose 8.3% to \$714.6 million from April, but average monthly orders for the three months ending in May were only \$528.2 million—down 9% from April and 57% from last year. U.S. market billings for 1985 are expected to be only about \$9 billion, down 20% from 1984. □

NEW STANDARD EXPANDS FM STEREO COVERAGE

Novel companding technique provides better signal quality to a larger area

Chicago

Within the past couple of years, broadcast technology for both TV and AM radio has seen major improvements with the authorization of new stereophonic broadcast standards. Now FM stereo radio broadcasting may also be due for its first major upgrade since the service was authorized in 1961.

The improvement is the result of a new broadcast and reception technique being promoted by CBS Inc. Called the FMX Extended Range FM Stereo System, the patented method was devised jointly by CBS and the National Association of Broadcasters as a way to significantly reduce noise and extend the range of FM stereo broadcasts, while at the same time maintaining compatibility with existing FM broadcast standards.

CBS wrapped up six months of field tests at FM public radio station WPKT in Meriden, Conn., last March, and has plans to run tests at a half dozen additional FM stations by year end, says Emil L. Torick, co-inventor of the system at the CBS Technology Center in Stamford, Conn. "And by this time next year, some receiver makers could have production units [incorporating the FMX system] to offer to dealers," Torick contends.

Results of the Meriden test were released during a demonstration of the FMX system at the International Conference on Consumer Electronics here this month. The tests showed a fourfold expansion of the reception area for FM stereo using the system, essentially equaling the area possible with monophonic FM, CBS says (see figure). Broadcast fidelity was also greatly improved because FMX eliminates most of the 26 dB of signal-to-noise penalty that is normally paid in going from a monophonic to a stereo FM signal, Torick explains. The Meriden tests showed improvements in signal-to-noise ratio of up to 23 dB.

New system. FMX works by employing a unique, complementary, compressor/expander system that results in what Torick calls "a new class of compander." The compressor works in conjunction with an adaptive expander in a

radio receiver that can conform to any compression curve transmitted by a broadcaster. This differs from conventional audio compander systems in which the expander must be carefully tuned to a set compression ratio, Torick notes. Because of this restriction, conventional FM receivers generally contain no expanding circuitry.

The key to the FMX compander technique is the use of the 38-kHz double-sideband suppressed carrier stereo difference channel as a decoding reference for the expander. This signal is used in an FMX receiver for determining the proper expansion ratio for a second, new subcarrier that FMX adds to the broadcast signal.

The second subcarrier—which is highly compressed before broadcast—is

nal levels, the response of the FMX re-entrant compressor is linear, providing about 20 dB higher gain than in the standard channel. But as the signal goes to higher-level inputs and the modulation level approaches 100%, the compression characteristic is automatically scaled back accordingly to prevent over-modulation, Torick explains.

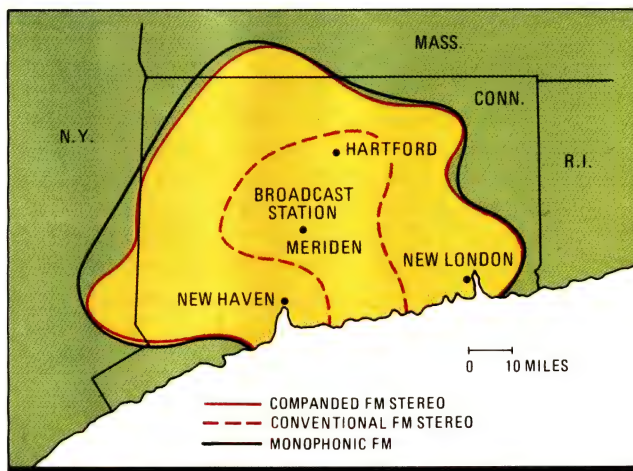
Cooperative effort. During about a year of full-scale development efforts on the FMX system, CBS has been working with Sony Corp. and with Circuit Research Labs Inc., Tempe, Ariz. Sony has supplied prototype FMX receivers, while CRL provided two prototype FMX broadcast stereo generators for use in the development effort. "We've been talking to a number of broadcasters who are anxious to get on the air and start testing," says Torick, who confirms that six additional prototype broadcast systems recently shipped to CBS from CRL will be used for that purpose.

Broadcasters' reaction to the potential for the proposed FMX system was generally positive, as was the response from manufacturers of broadcast equipment, receivers, and audio-processing integrated circuits. "I think it sounds like quite a breakthrough in terms of signal improvement," says Kenneth H. MacDonald Sr., chief executive officer and owner of MacDonald Broadcasting Co., a Saginaw, Mich., firm that operates three FM and three AM radio stations.

"I'd be happy to volunteer one of my stations for a test," MacDonald says.

But CBS, which hopes to provide FMX licenses to broadcast equipment and receiver manufacturers for a nominal fee, still faces a chicken-and-egg situation in getting the system into the field. "It's a very clever system, but whether we implement it or not depends on whether the receiver manufacturers build it into their receivers," says Robert Orban, co-owner and chief engineer at Orban Associates Inc., a San Francisco broadcast-equipment maker.

Conversely, receiver makers want assurances that the system will be put on the air by broadcasters before commit-



Expanding coverage. Reception area for FM stereo is increased fourfold with the new broadcast standard, but acceptance from radio manufacturers and broadcasters remains an open question.

modulated at the same 38-kHz frequency, but in quadrature to the existing stereo difference channel. Conventional receivers do not detect the quadrature stereo subcarrier, and thus continue to operate using the original subcarrier. But FMX receivers will be equipped for automatic switching to an FMX mode upon the detection of a subsonic identification tone that is broadcast in the new FMX quadrature channel.

The FMX design gets around potential problems with broadcast overmodulation at high audio levels (which could result from the sum of the two 38-kHz subchannels) by using what CBS is calling a re-entrant compressor. At low sig-

ting to the approach. For CBS's part, Torick says that no Federal Communications Commission rule change would be required to implement FMX; it is compatible with the existing standard. The next major step for CBS is "to get started on the development of an IC" that could be used in FMX receivers. "That's what the receiver people are waiting for," he says.

That process began at the ICCE in Chicago, where CBS talked to representatives of several chip houses about the idea, Torick says. "We wouldn't commit to it until we've seen more field-test results," says Frank H. Hilbert, manager of the modulation systems laboratory for Motorola Inc.'s Corporate Research Center in Schaumburg, Ill.

But an official from another well-known semiconductor manufacturer who also saw the ICCE demonstration told *Electronics* that his firm is planning to develop an FMX audio-processing chip. The effort is dependent on additional proof that the CBS-backed system works as represented and on the outcome of talks with several Japanese receiver makers, says the official, who asks not to be named.

By various estimates, an FMX-based IC could be sold in volume to receiver manufacturers for \$1 or less. On the broadcast-equipment side, Torick estimates that FMX circuitry could be added to the FM stereo generator for a \$2,000 to \$3,000 cost premium over available equipment. —Wesley R. Iversen

FACTORY AUTOMATION

CHIP MAKERS MAP PLANS FOR FACTORY-NET BOARDS

Santa Clara, Calif.

A small but powerfully backed Silicon Valley startup, Industrial Networking Inc., has stolen a march on established chip makers by coming up with a two-piece very large-scale-integration chip set for connecting equipment to factory local-area networks. INI's CMOS gate arrays implement the Institute of Electrical and Electronics Engineers' 802.4 token bus specification, the basis for the rapidly emerging Manufacturing Automation Protocol (MAP).

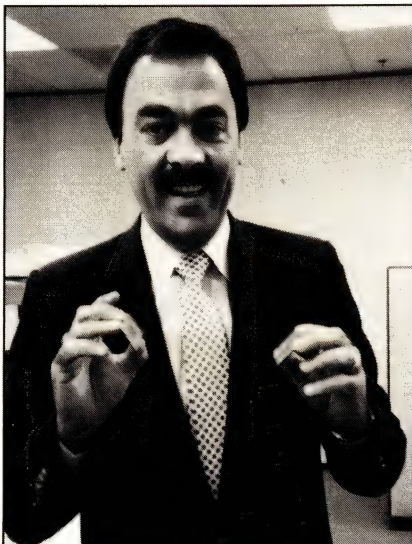
INI will not sell the chips. Instead, it will put them into board-level products that will support all seven layers of the International Organization for Standardization's networking model, adopted by the General Motors Corp. as the framework for its broadband-LAN standard for automating production lines. The boards will plug into the input/output channels of computers, controllers, robots, guided vehicles, storage devices, vision systems, and other equipment linked by the MAP. There are other token bus implementations—for proprietary LANs—but INI's are the first chips to support the 802.4 standard.

New designs. Motorola Inc., Intel Corp., and Gould/AMI are also working on 802.4 chip sets, the latter jointly with Concord Data Systems Inc., whose \$3,500 controller is the present—and expensive—entry point to MAP. Motorola and Intel will use the INI boards in MAP products as they complete their own custom VLSI chip sets. All three sets are expected next year. INI, which took the quick route to market with gate arrays, promises boards for equipment to be used at this November's Autofact show in Detroit.

GM and Boeing Computer Services Co. will jointly manage a network of some 19 vendors at Autofact, with GM handling the factory section and Boeing the office section under its Technical Office Protocol.

INI was formed 18 months ago by Ungermann-Bass Inc., which provided 60 technical personnel, and General Electric Co., which put up \$6 million, specifically to build networks for the industrial-automation market. The new company hit the ground running. It inherited Ungermann-Bass's LAN expertise, acquired in six years of helping to develop that market, and the token technology U-B picked up when it bought out Amdax Corp. in 1983.

U-B already had considerable chip



MAP-module man. INI president Joseph Schoendorf plans a family of MAP modules for automated factories.

technology; founder Ralph Ungermann once ran Zilog Corp., and U-B developed the first Ethernet (802.3) chip set in 1982. GE, INI's other parent, is a long-time leader in factory automation.

The INI gate arrays, developed with Japan's Toshiba Corp., perform the physical and data-link operations that make up the bottom two layers of the ISO model as defined by 802.4. The INI boards will also contain an I/O section, which will be different for each piece of equipment; a MAP software communications processor; hardware for layers 3 and 4 and software for the rest; and a 10-Mb/s broadband modem.

The entire board and all seven protocol layers were completely simulated during the chip design, so that critical timing patterns would work in a real system. The chips themselves, which contain a total of 14,000 gates, worked "the first time out of the oven," says INI president Joseph P. Schoendorf.

First out of the gate. "A lot of people have made promises," says Harvey Freeman of Architecture Technology Inc., Minneapolis-based LAN consultants. "INI will be out there first; it will get a lot of orders."

It already has. Quick to design and build the chips, INI has been no slouch at lining up contracts either. Motorola will use INI's boards to connect VME-bus products. Intel sees them as a Multibus link. GMF Robotics, Troy, Mich., will put them into its robots; and with Ungermann-Bass, INI will work with General Motors/Electronic Data Systems to automate five plants in GM's Truck and Bus Division. That contract is for the largest MAP-based factory network to date, Schoendorf says.

At Autofact, Intel will have equipment in both Boeing's 802.3 baseband network and GM's token-bus broadband net. It will also supply boards for the routers, which attach the two nets at ISO level 3, the network level.

The momentum is so great that Intel went to INI for hardware and to Westinghouse Electric Corp. for upper-level ISO software to meet GM specs, says Leonard Magnuson, marketing manager for OEM communications products at Intel's Systems Group. Motorola, too, got carried along, contracting for the INI board while its MVME 335 token-bus board is readied for 1986 introduction. The INI board is an interim product pending working silicon on its own token bus, a Motorola spokesman said.

Concord Data Systems, meanwhile, has been working for 18 months with AMI on a custom three-chip token-bus set. One chip will control the physical layer, one is a direct-memory-access chip to interface with the host processor, and one a microprogrammed protocol chip. The DMA chip will have two modes so

that it can work with both Motorola and Intel microprocessors, says Robert Douglas, Concord's director of engineering. The set will be ready in the first quarter of 1986. AMI will eventually market the chips separately.

Ungermann-Bass used its token expertise to design and build an 802.5 token-ring chip set en route to the development of the token-bus arrays. So it will be waiting when IBM Corp. releases its long-promised token-ring office LAN.

Schoendorf, who came to INI last February after 18 years in marketing at Hewlett-Packard Co., says the company will develop a family of MAP modules that will act as telephones for factory equipment. "Any machine on the floor can call up any other. As America re-industrializes, it will have to rewire. All of the biggest manufacturers will build new plants, tied together with MAP." INI, he says, wants to be the telephone company. —Clifford Barney

IMAGE PROCESSING

TV/PHOTOPRINT SYSTEMS SMOOTH SCANNING LINES

Tokyo

The proliferation of image sources from TV broadcasts, video cassette recorders, computer graphics, and the upcoming wave of electronic still cameras has increased the demand for photograph-quality copies of color video images. To address this demand, three Tokyo-based organizations have developed prototype systems that produce photographic prints with no visible scanning lines. Moreover, they look like ordinary color prints because they use conventional silver halide print materials.

A system that makes 4-by-5-in. instant color prints or 2¼-by-2¼-in. positive color transparencies has been demonstrated by a group at the Science and Technical Research Laboratories of NHK (Nippon Hoso Kyokai, the Japan Broadcasting Corp.) headed by Shin Ohno, assistant manager in the Recording and Mechanical Engineering Group. Another system, which makes 5-by-7-in. prints on color enlarging paper, was developed under the leadership of Yasuo Uchida, director of Electronic Imaging Laboratories at Konishiroku Photo Industry Co. It was shown in Chicago at this year's Summer Consumer Electronics Show.

Technical cooperation. At Fuji Photo Film Co., senior managing director Eiichi Mizuki says that his firm provided NHK with technical cooperation and he claims that Fuji has developed several of its own systems. Yet Fuji has shown prints made with only one type of system, which it has not described.

NHK is a user-fee-supported broadcaster that blankets Japan with two TV networks and maintains its own research labs. Fuji Film is Japan's largest manufacturer of photographic films and papers, and Konishiroku is a substantially smaller No. 2.

The photographic systems feature substantially higher quality than non-silver-halide systems that have been proposed, including the thermal transfer systems developed by Sony, Hitachi, and

others [*Electronics*, March 24, 1982, p. 76, and *ElectronicsWeek*, Nov. 26, 1984, p. 34].

The thermal-transfer systems can reproduce a gray scale with about 64 steps at best; the instant-print film has a capability of about 128 steps and photographic film or paper, 256 steps. Scanning lines are clearly visible in thermal-transfer-system copies.

Other print systems use ink jets or ribbons in which density of printing is changed by varying the colored area of each pixel in a manner similar to halftone printing. But here, resolution tends to be low, the gray scale has a limited number of steps, and the result is less attractive than photographic prints.

All of the photographic hard-copy systems are conceptually similar although they differ in detail. They all require a semiconductor video frame memory to store a complete picture. The memory is

necessary because the photographic material must be exposed for a much longer time than one TV frame period. Moreover, storage of the picture information permits interpolation of additional scanning lines so that a line structure is not visible in the finished print.

All systems use 480 horizontal scanning lines for stills, but 240 lines for pictures with rapidly moving subjects to avoid blurring.

Film is exposed by light emitted from a flattened cathode-ray tube with only three stripes—one for each primary color—on its faceplate. NHK and Konishiroku buy variations of the same CRT from the same manufacturer, Japan Radio Co. of Tokyo.

Lens synch. In the NHK system, the picture elements from the CRT are focused onto the instant-print film by a lens that moves in synchronism with the signal to provide vertical scan over the height of the film. The red, green, and blue signal components for each horizontal line are fed to the CRT in sequence, and the beam is deflected vertically to the corresponding color's phosphor stripe.

NHK uses only instant-print or transparent film because it is easier to work with, but Ohno says that a commercial system could be designed for negative film without increasing complexity or difficulty.

Konishiroku bases its system on enlarging paper to reduce running cost. The technology uses an optical-fiber CRT with which the paper is almost in contact, and vertically sweeps the paper past the tube. This setup concentrates the full phosphor light output onto the enlarging paper. —Charles L. Cohen



Off the air. High-resolution color prints that show no visible television scanning lines are possible through a system for making photographic prints from video stills.

USAF WORRIES ABOUT DEMAND SURGES

Hanscom AFB, Bedford, Mass.

Once the kingpin customer of the electronics industry, the U.S. military has begun to worry about its dependence on an industry that no longer depends on it. A major concern: after a year-long study, the U.S. Air Force has concluded that its suppliers would be unable to increase electronics production quickly enough to meet the demands of a prolonged conflict.

In its study, Pursuit 2000, recently completed but not yet distributed through its hierarchy, the Air Force analyzed the country's electronics-gear production base to gauge industry's ability to "surge" its production rapidly. Among the findings:

- Defining a surge as a doubling of production within six months, the study concluded that the U.S. electronics industrial base could not pull off such a feat; semiconductor production was singled out as a particular problem.

- The military's share of semiconductor use, currently about 7%, will shrink by more than half in the next decade. Even the gallium arsenide semiconductor market, which the military now dominates, will be commercially driven within five years.

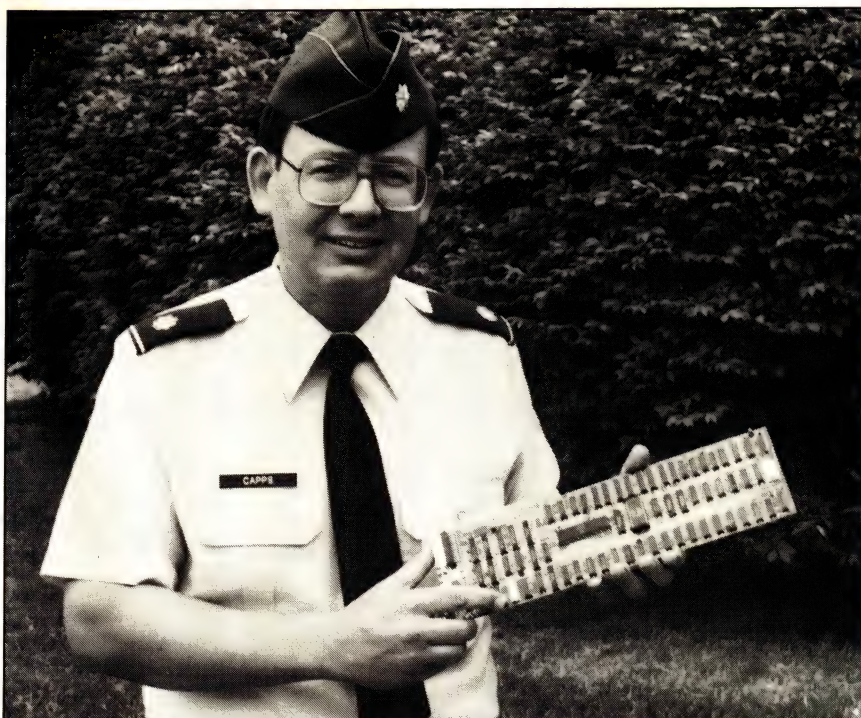
- The military must make producibility a higher priority and accommodate itself more to commercial practices.

- To increase responsiveness and increase productivity, the military should focus more attention on the "sub-tiers" below the level of prime contractors, which are responsible for component manufacture.

- Testing would be a major bottleneck in ramping up production.

Force multiplier. Prepared by the Electronic Sector Management Center of the Air Force, the report emphasizes that electronics serves as the "force multiplier" for the service, providing numerically smaller forces with the potential to overcome greater numbers. In fiscal 1984, the Department of Defense spent \$97 billion on electronics. The Air Force spends more than one third of its budget on electronics. Even so, the military has been slow to recognize that its position as an industry force has for some time been supplanted by the commercial sector.

"That's a significant thing we have to be aware of," says Air Force Maj. Gen. Brien Ward, chairman of the steering committee that oversaw the study. "The market is not necessarily driven by our needs."



Go with the flow. Maj. Harris Capps of the Air Force Electronics Sector Management Center says that insistence on ceramic packages, among other things, keeps the military out of step with commercial semiconductor practices, such as the overwhelming use of epoxy.

Maj. Harris Capps, director of the ESM center, says this changed relationship between the military and the electronics industry was examined in light of the DOD's newly emphasized priority for the need to satisfy the surge requirements of longer-term conflicts. The criteria for surging production, defined as a "peacetime scenario," include that there be no impact on commercial product lines and no product switching.

Semiconductor production is among the most serious obstacles to a surge in weapons manufacturing (see table, p. 22). Given that more than 80% of military semiconductors are manufactured offshore, the military is understandably concerned about supply vulnerability and responsiveness.

The report further expects the current military market to decline from 7% of semiconductor sales to 3% by 1995. In gallium arsenide, where the military held a dominant 74% market share in 1984, the sector will become driven by commercial users as the DOD share drops to 33% by 1990.

In addition to the relatively minor overall semiconductor market share, the services' insistence on ceramic packages makes their business less appealing to chip makers. "We had a major company tell us, 'We're not go-

ing to be bothered with you,'" says Ben LaPointe, program manager for DHR Inc., a consulting firm based at Hanscom that helped prepare the report. "They said the whole ceramic business was 5% for them and the total Air Force business 1.5%."

Numbers deceiving. But Ronald Williams, who chaired the integrated-circuit panel for the Pursuit 2000 study and is operations manager for the Military Products Division of the Semiconductor Group at Texas Instruments Inc., says the military's importance to the industry outstrips its percentage of market share. For one thing, says Williams, the military is a stable customer, noting, for example, that military market share is greater now than last summer (when the panel met) because of the decline of consumer business. The stability of military business allows manufacturers to plan accordingly.

"I was the first to go with a dedicated military facility," he says. "And everybody is headed that way [doing business with the military]. Even if it goes to 3%, the military business is still going to grow."

Peter Green, also a panel member and now marketing manager for custom products at Intel Corp., agrees that military clout in the semiconduc-

tor business exceeds its percentage of the business. This is particularly the case for companies that depend heavily on products using very large-scale integration, which increasingly turn up in military gear.

Green believes the military should exploit the rapid expansion of nonmilitary research and development, which results in many new products. He says that this has begun to happen in the 32-bit microprocessor market, where commercial products are moving rapidly and being looked at by the military. But overall, he finds the military's attitude toward commercial products varies widely according to program officer. "That's something that needs more top-down direction," Green says.

But the military, both in its lengthy program-production spans, which can exceed 10 years, and its expectation that weapons systems have a mission lifetime in excess of 20 years, often exacerbates problems of coordination with industry. Although the commercial sector is busy shrinking semiconductors and adding functions to succeeding generations, the military often tries to hold back the clock and demands no changes in its semiconductors. The result is that military semiconductors are sometimes obsolete before the first production unit is assembled.

In terms of surging production, industry's ability to respond to military demands often may confront capacity limitations. Though the current slowdown has created surplus production capacity, semiconductor plant utilization over the last decade never dropped below 70%, and, in more than one year, utilization exceeded 90%.

Labor intensive. Testing poses another limit to increasing production for military requirements, according to the report. In addition to high costs and long delivery times for equipment, semiconductor inspection is labor intensive. The report cited in particular the rapid proliferation of unique, company-built, dedicated equipment as a problem. And there is also no excess capacity for standard test and burn-in functions, let alone special equipment.

The test area is particularly ripe for military-supported modernization programs. For example, the increased use of automated semiconductor-inspection equipment, estimates LaPointe, could return about 10% of the offshore semiconductor production to

THESE KEY INDUSTRIES COULDN'T DOUBLE THEIR OUTPUT

Industry	Bottlenecks
Semiconductors	Raw material cycle time Capacity 85% to 95% utilized 90% of assembly offshore 70% of testing offshore
Electrical subassemblies	Obtaining mil-spec components Lead times
Printed-circuit boards	Raw material (polyimide)
Connectors (some types)	Industry at near capacity
Machining and forming (some segments)	Equipment capacity Manpower constraints
Equipment shelters	Raw materials
Cabinets	Manpower/Long lead times
Composites and nonmetal materials (some types)	Offshore manufacturing

SOURCE: U.S. AIR FORCE STUDY

this country, potentially meeting many of the military's needs.

In previous studies of military production, attention was focused on prime contractors. However, Capps of ESM says that in many cases production increases or cost reductions depend on component manufacturers, where more than 50% of the systems are made. But programs to encourage

modernization have not penetrated that level.

At the distributor's level could be a hidden source of surge capacity, LaPointe says. On a given day, a distributor may have one quarter of his yearly stock on hand, he says. If it were the right material, it would provide a significant boost to a production hike.

Among the shortcomings underscored by Pursuit 2000 was that the military does not have a plan to surge production. An effective plan for rapid production ramp-up must be integrated across all military services and backed

by agreements with manufacturers, says LaPointe.

The report also concluded that the military must increase its efforts to accommodate itself to the commercial sector. Just replacing many ceramic packages with newer epoxy materials would save an estimated \$30 million and return some production to the U.S., says Capps. —Craig D. Rose

COMMUNICATIONS

SCANNER SENDS COLOR PHOTOS IN A JIFFY

Herzlia, Israel

The immediacy of TV news reporting has put pressure on print media to speed up reporting time and improve their graphics. Trying to compete, newspapers currently either use original photographs sent by air courier, or analog separations by wire services—both with unacceptable delay times.

Now Scitex, a Herzlia firm that specializes in computer-imaging technology, has developed a transportable color-separation scanner called the Satlight. With it, print-media workers can transmit—in a matter of minutes—scanned and digitized 35-mm color slides, black and white slides, or line art from one remote location to any other in the world. The digitized pictures can be fed directly into computer-driven graphic designers at the newspaper for cropping and layout, and then printed minutes later.

The prototype hardware had its first tryout at the Olympic Games in Los Angeles last summer. Using it, the newspaper *USA Today* was able to hit the streets nationwide with color shots of the day's events even before the local newspapers did. By contrast, the method currently used by the Associated Press requires color photos to be scanned three times (one for each primary

color), sent as black and white analog signals and then digitized in the New York office before being retransmitted to AP members. The initial transmission from the field takes 9 min. per color.

Scitex, however, has competition in the offing. Both Sony Corp. and Canon Inc. have experimental electronic cameras that can transmit images [*ElectronicsWeek*, Aug. 6, 1984, p. 18], and Nikon Inc. experimented with color transmission at the Olympics with a \$10,000 direct-scan analog transmission system normally used for sending black and white.

Scitex unveiled the equipment, which sells for \$100,000, at the American Newspaper Publishers Convention in Las Vegas last week. About the size of a car's trunk, the unit consists of a scanner, an image processor, a monitor, and electronics for display, data compression, and telecommunications. The unit, besides sending, can receive instructions such as software updates from the head office.

Optics crucial. At the heart of the system are the scanning electro-optics. A stabilized halogen light source with infrared cutoff illuminates the 35-by-24-mm frame with uniform brightness. The image, captured by a charge-coupled-de-



Compact. Scitex's Satlight—consisting of a scanner, image processor, monitor, and electronics for display, data compression, and telecom, fits into a car trunk.

resolution, many pictures can be sent to an editor in a short period of time, allowing for selection. Output is 8 bits/pixel, providing 256 levels of shade for each separation. Scan time is 90 seconds per frame for a full-color scan.

After scanning, the image is stored on a built-in 5¼-in. Winchester disk with an unformatted capacity of 46 megabytes

and a transfer rate of 5 Mb/s. Pictures can be called to the 10-in. monitor for verification and basic color correction.

The Satlight can compress pictures by up to 80 times using a proprietary algorithm. Compressed pictures allow for faster transmission time. For a 1:8 compression, the process takes 4 min plus 7.5 s to transmit.

—Jesse J. Leaf

establish a name while the field is still growing.”

As to whether Telefunken's experience in consumer electronics could be applied directly to robotics, Dowald says, “In a limited sense, our experience with cameras and TV monitors can be useful in vision inspection, but even there we had to design new equipment to interpret the gray-scale differences that inspection systems depend on. You can't just take a video image of something and claim you've inspected it.”

Telefunken is stressing the ability of its inspection equipment to work in a factory's ambient light, which Dowald admits is more a carryover from the company's experience in military vision systems than in consumer electronics. But when a product must be manufactured and distributed in quantity, the company's experience in the consumer market and its recognized name will come into play, he says.

Home-grown knowledge. Sony is using its in-house experience in assembling components for video equipment to break into the U.S. assembly-robot market. Says Henry Otsuka, manager of Sony's production technology center, “We're actually aiming at two markets: one is in the area of light assembly for a variety of small firms; the other is in pc-board assembly.” Otsuka believes a potentially large demand exists for simple, low-cost robots among companies whose products require the manipulation of relatively large components. Automotive subcontractors, for example, who assemble subsystems such as windshield wipers and dc motors, may form a ready market.

The intrinsically more challenging area of pc-board assembly is a new one for Sony, but the company's experience with cameras and TV equipment may give it an advantage over other robot

ROBOTS

CONSUMER-GOODS GIANTS AIM AT ROBOTICS MARKET

Detroit

Some of the biggest names in consumer electronics are under the spell of another potentially huge market—industrial robotics. Panasonic Industrial Co. led the way last year with the introduction of its Panarobo line of assembly robots.

At the Robots 9 show in early June, a half-dozen other consumer electronics giants announced their entry into the U.S. industrial robotics market. Some are shooting at familiar targets, such as Nikon Instrument Group with charge-coupled-device cameras for visual inspection. Others are aiming for new sectors—Sony Corp., for example, with its high-speed robot for printed-circuit-board assembly.

“You can't really say you're in the world market without being in the U.S.,” says Tadashi Munakata, assistant specialist of Toshiba Corp.'s robot systems group. “We're looking at timing, and this is when we believe we should introduce our machines. We're big in Japan,” he explains. “But the market is expanding so fast over here, we want to get in before the shakeout.” No one is predicting an imminent shakeout, but Munakata's comments were echoed by most new entrants in the robots market

from the consumer electronics ranks.

Dieter Dowald, product specialist for automation technology at AEG Telefunken in Seligenstadt, West Germany, stresses that his company is “not looking to fill a particular void in industrial robotics, but simply sees the overall market getting bigger, which makes room for us, too. And it's better to es-



A new breed. Sony's experience with video technology may help it integrate vision with its new line of industrial robots, which the Japanese company is promoting for light assembly.

firms that must integrate the required visual sensing from outside vendors, Otsuka says.

Jeff White, a marketing manager with NEC Corp.'s broadcast products division (NEC has no separate robotics division in the U.S.), takes a more cautious approach than Otsuka. "For now, we just want to sell our cameras to systems integrators," says White. "We tried to get into the U.S. robot market a few years ago and it didn't work, so we're sticking with a product we know." Like Nikon, NEC is marketing its CCD cameras for visual inspection, but is also taking them a step further by seeking out original-equipment manufacturers who will apply them as robot sensors.

White stresses that NEC robots are

big in Japan (and NEC will be promoting a new line of them at the International Robotics Show in Tokyo this September), but that it won't be until next year that they are introduced into the U.S.—probably by the firm's New Products Division in Melville, N.Y.

A NEC manager who requested anonymity said that his company "would be crazy not to get in [to the robot market] over here. It's growing like wildfire, and it's not shaken out yet. The main thing is to get in while it's still early."

Market figures from the Robotics Industries Association, which sponsored Robots 9, support this analysis: sales of industrial robots to U.S. factories in the first quarter of 1985 were up almost 60% from a year ago.—David M. Weber

say that the Phoenix, Ariz., company's previous emphasis on microprocessors and memory devices spread its production resources too thin during the boom years to allow a peak MOS FET effort. In addition, the company's vested interest in bipolar devices kept officials too long from making an all-out MOS effort, according to some sources.

But with an overall slump in the chip business, Motorola executives have shifted their sights to product sectors where growth potential now exists—including MOS FETs and application-specific integrated circuits, to name two.

"It's no secret that we now have lots of megabuck front-end capacity," says Paul V. White, Motorola's vice president of marketing for discretes. He leaves no doubt that these big production guns are trained on the MOS FET arena, a business that he calls "no flash in the pan."

Though the macho code of selling semiconductors traditionally calls for competitors to downplay each other's important moves, other MOS FET firms truly seem to welcome Motorola's stronger effort. At International Rectifier, for instance, Allan M. Tregidga, executive director of the Electronic Business Group, sees the Motorola move as one

SEMICONDUCTORS

MOTOROLA IN BOLD BID FOR MOS FET LEAD

Los Angeles

In the bleak landscape of the semiconductor industry, where product demand has shriveled so drastically, one flourishing oasis continues to beckon parched manufacturers—power MOS FETs.

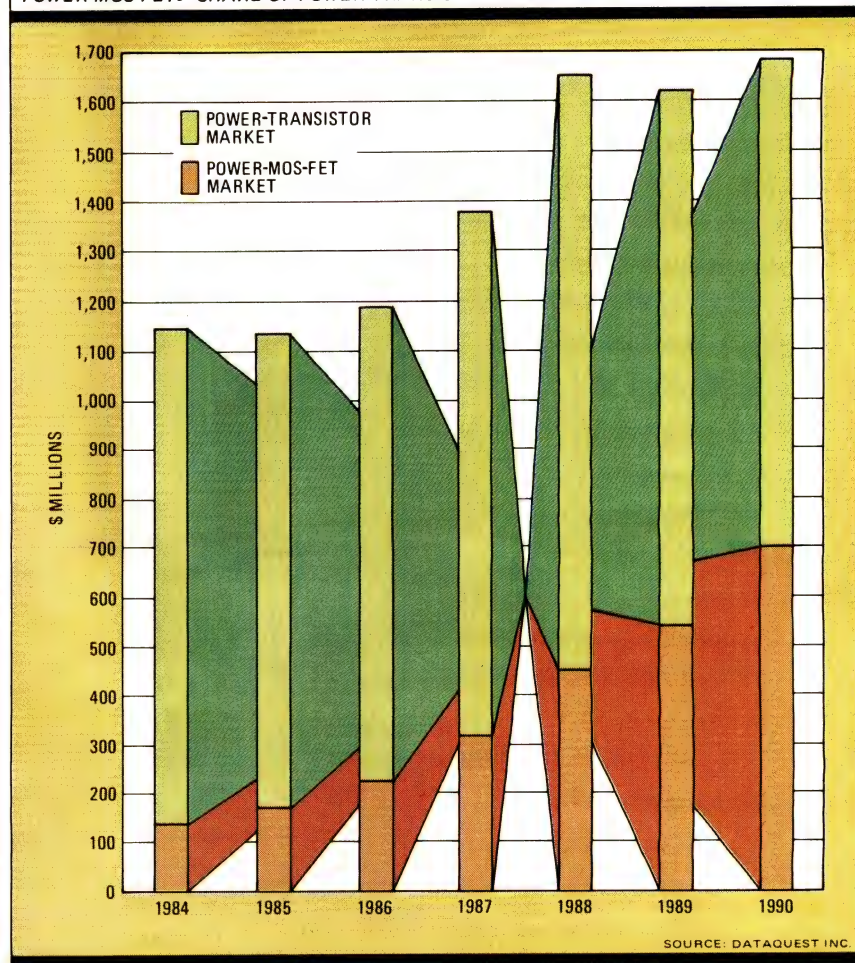
From a curiosity status in the late 1970s, the popularity of these innovative devices took off slowly. But power MOS FETs, offering better performance with lower currents, simpler external circuitry, faster operating speed, and improved efficiency, have steadily made inroads into the workhorse bipolar transistor marketplace. Still, the biggest eye-opener, even to proponents of power MOS FETs, has to be the devices' uninterrupted growth in demand in the face of the worst semiconductor downturn in at least a decade.

A predictable scenario for the MOS FET market, therefore, must include a greater presence by the major manufacturers. That scenario is now emerging. Late last month, Motorola Inc.'s Semiconductor Products Sector, the largest house with a stake in the MOS FET business, signaled its intention for an all-out assault on the market, with volume price cuts averaging about 30% on some 70 low-performance commodity parts with ratings up to 250 V and 25 A.

Not previously a price leader—that role has most recently been played by RCA Corp.'s Solid State Division—Motorola in the past year moved into the No. 2 sales spot, behind volume leader International Rectifier Corp. Motorola's Discrete Products Group admits that it has taken aim on market share, and plans further cuts across the board for its line of TMOS devices.

Motorola's effort to seek MOS FET leadership strikes competitors and market observers alike as a major development, but it is at least several years overdue, in their view. Motorola sources

POWER MOS FETs' SHARE OF POWER-TRANSISTOR MARKET RISING



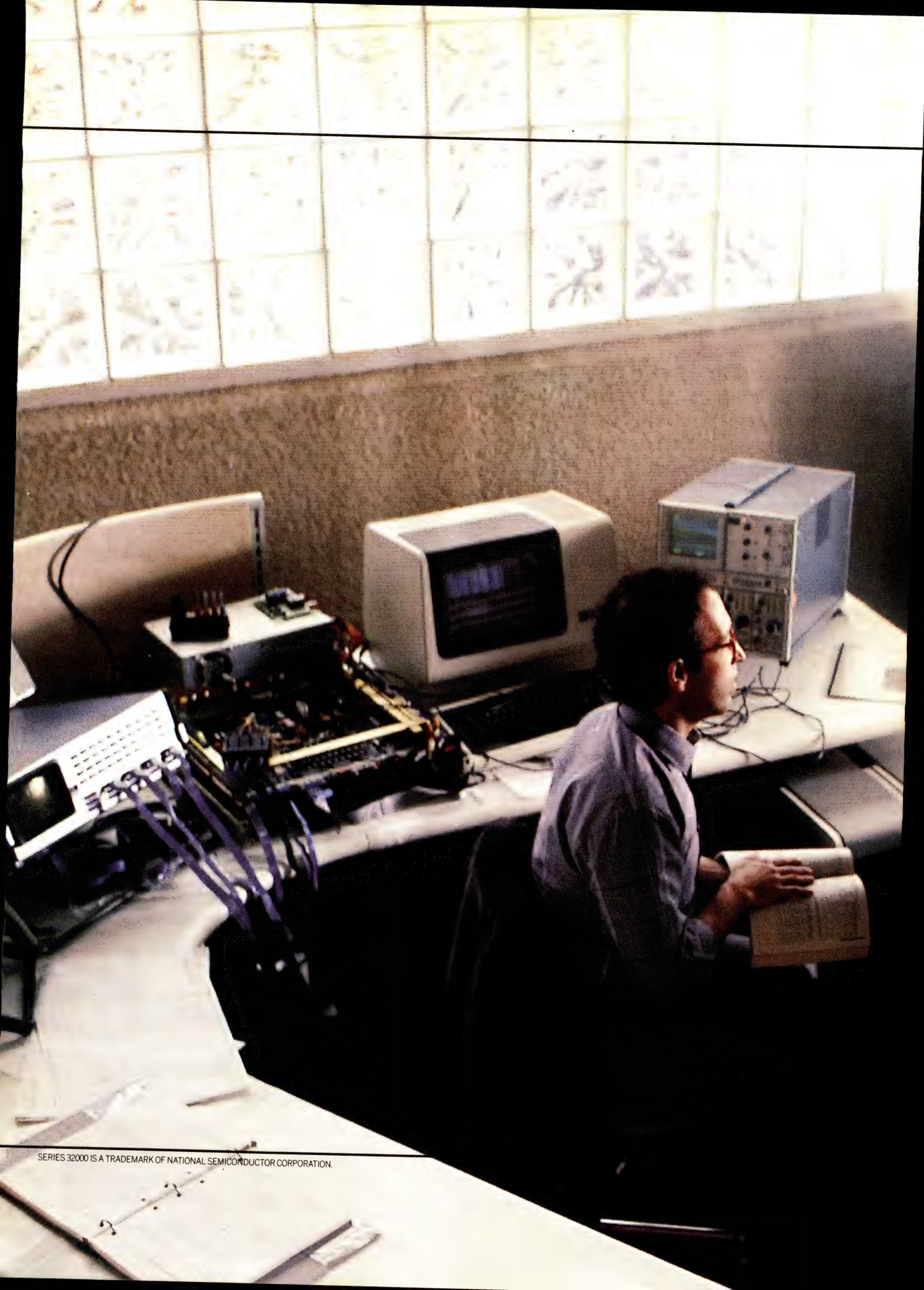
A new radar can map military targets with high resolution equal to that of infrared devices, even in rain and other bad weather. The Advanced Synthetic Aperture Radar System (ASARS-2), designed to complement electro-optic sensors, is flown on a U.S. Air Force TR-1 reconnaissance aircraft and provides real-time radar imagery to a ground station. ASARS-2 operates in all weather at ranges far exceeding the capabilities of infrared and other electro-optic devices, thanks to new state-of-the-art signal processing and other advances. The Air Force gave the system an excellent rating after it underwent strict operational performance tests as part of a "fly-before-buy" program. Hughes Aircraft Company is producing the system under a development and production contract. Eventually ASARS-2 is expected to be adapted for tactical aircraft and mobile tactical stations.

NASA's Project Galileo Probe, which will explore the planet Jupiter later this decade, must arrive at a precise angle if it is to carry out its measurements of the chemical composition and physical state of the Jovian atmosphere. The Hughes-built probe will arrive at 107,000 miles per hour, fast enough to travel between Los Angeles and Las Vegas in nine seconds. If the probe hits at too shallow an angle, it will skip off into space; too steep, it will be reduced to ashes. Even at the proper angle, the probe will encounter extremes never before faced by spacecraft. In less than two minutes, much of the forward heat shield will be eroded by temperatures of thousands of degrees. With atmospheric entry forces reaching 360 times the gravitational pull of Earth, the 742-pound probe will take on a weight equal to an empty DC-10 jetliner. Project Galileo is scheduled to be launched from the space shuttle in May 1986 and to arrive at Jupiter in August 1988.

Two versions of a new color image recorder, designed to provide the means to capture on film the precise color image from television monitors, have been introduced by Hughes. The high-fidelity TV recorders, Models CIR 100 and CIR 200, interface directly with a color display. They contain their own high-resolution, flat-face cathode-ray tubes, primary color filters, and controls for exposure and color. They record on either 35-mm or instant film with the high resolution, brightness, and color range necessary for scientific, medical, or other applications where accuracy is essential.

Lasers soon will be inspecting solder joints of fighter aircraft radars, thanks to new manufacturing technology being set in place at Hughes. Solder joints will be examined by a computerized technique using lasers and fiber optics, the glass threads that carry laser light transmissions. The process will free manufacturing personnel from tedious and time-consuming inspections of more than 36 million solder joints created in a single year's production. The project is part of an Industrial Modernization Incentive Program (IMIP) awarded by the U.S. Navy and Air Force. IMIP is a share-the-savings concept that will reduce costs of the F-14, F-15, and F/A-18 radar programs by more than \$10 million, while improving the quality and reliability of the systems.

Hughes' Santa Barbara Research Center is seeking experienced engineers and scientists to further develop advanced IR focal plane technologies. We need custom integrated circuit designers, nuclear effects engineers, material scientists, semiconductor device scientists and process engineers, and IR system analysts. To learn how to become involved in this innovative technology, contact the Santa Barbara Research Center, Professional Employment, Dept. S3, 75 Coromar Drive, Goleta, CA 93117. Equal opportunity employer. U.S. citizenship required.



SERIES 32000 IS A TRADEMARK OF NATIONAL SEMICONDUCTOR CORPORATION.



"I can tell by the look on your face. You've been talking to marketing about the new system again."

"How're we going to do it if you have to create memory management and floating point units out of thin air?"

"That's not a problem—"

"On time and on budget?"

"We're going to use a complete 32-bit chip set—"

"We can't make a system out of data sheets. We need product, not promises."

"I'm talking about the Series 32000 family. It's real. It's here. I like it and the software people love it. What more do you want?"

"Can we start today?"

Today, only one 32-bit microprocessor gives you all the power you want, and all the parts you need.

If you're building an extraordinary new system, you can't do it with less than extraordinary components. And you certainly can't do it on time without floating point and memory management units.

Of all the available 32-bit microprocessors, only one delivers supermini performance from a chip set you can work with today. Series 32000™ is the world's most complete 32-bit microprocessor family, with CPU, MMU, FPU, TCU, ICU and DMA controllers in place right now.

So instead of creating essential components from scratch, start your design today with Series 32000, the complete 32-bit family.

For all the facts, write to:
Series 32000, MS 23-200
National Semiconductor
2900 Semiconductor Drive
P.O. Box 58090
Santa Clara, CA 95052-8090



**National
Semiconductor**
We're doing it.

THE SUPERMINION A CHIP

giving MOS FETs increased importance.

"Motorola is the most significant corporation in the marketplace, and its actions will fuel growth," Tregidga says. Price cuts in the range of 25% a year are inevitable because of economies of scale and other efficiencies, and serve customers well, he says. International Rectifier expects to cut its prices soon, since volumes are rising. Financial analysts put the firm's production of its Hexfet line at about \$1.1 million weekly, with \$2 million in sight by year end.

All industry hands agree that pricing itself does not dictate market share as most competitors quickly fall into line. The key to getting more business these days is quick delivery, of no more than eight weeks, according to Arthur E. Fury, vice president of marketing at Siliconix Inc. "In a marketplace reeling from a glut of semiconductors, purchasing agents expect no less," he notes.

International Rectifier seems most vulnerable on this score, according to competitors, and they hope to make the most of it. They say the market leader's delivery times stretched out to six months or more earlier this year. New fabrication facilities have cut this in half, International Rectifier officials say, and eight-week delivery is planned by August.

Another subject MOS FET firms agree on is the importance of getting established with customers during these slow times, when equipment manufacturers concentrate on new designs for improving their wares. While MOS FETs offer better performance than bipolar devices, they are also more expensive. Last year, power MOS FETs cost up to 50% more than bipolar transistors, but this differential is narrowing to the point where high-performance MOS and bipolar transistors (in the submicrosecond switching range) are at virtual parity, sources say. For slower parts, on the other hand, bipolar types are still much cheaper.

Motorola claims, in fact, that with its cuts, the price of doing power functions with MOS FETs is comparable with bipolar, taking into account the reduced parts count. The company should know, since it has the world's top slot in bipolar transistors, with annual sales of about \$300 million at peak years.

Although solid market figures have been hard to come by in the past, new projections from Dataquest Corp. show that the power-MOS FET market is expected to reach \$702 million in 1990 from last year's \$136 million, for a compound annual growth rate of 32.6%. These projections look good to market participants. Their only caveat is a familiar one to U.S. semiconductor houses: the entry of a swarm of highly competitive Japanese firms into the market.

Japanese vendors' typical marketing pattern is to prove the product in the domestic Japanese arena before going after U.S. customers. This first phase is already under way, with Japanese vendors selling MOS FETs in their home market. "There's no doubt the Japanese have the product," says Paul R. Thom-

as, power marketing manager at RCA Solid State. "The only question is when they go on line and bring it here.

Warns Motorola's White, "Those fellows come in and don't play by the same ground rules. They can lose millions [of dollars] for 10 years and drive everybody out."

-Larry Waller

COMPUTER-AIDED ENGINEERING

PC DESIGNERS GET THEIR OWN FOUNDRY

Attleboro, Mass.

Systems-house chip designers usually develop a circuit on a work station and then farm out the fabrication to a silicon foundry. Board designers may soon work this way too, thanks to Augat Inc., one of the largest manufacturers of integrated-circuit sockets and printed-circuit boards. The firm has readied design software for low-cost work stations and is set to manufacture boards based on computer-aided-engineering designs.

Augat calls its CAE software Quikdraw. With it, users of Futurenet Corp.'s Dash electronic-design work stations based on IBM Corp. Personal Com-

Augat offers its CAE software for IBM PC-based work stations

puters, PC/XTs, or PC ATs can create pc-board component-placement drawings. In turn, information from these drawings is extracted and transmitted to Augat's VAX data-base computer [*ElectronicsWeek*, Sept. 24, 1984, p. 29]. The VAX converts the data into the CAD/CAM format needed for manufacturing pc boards. Augat supplies the software, on a floppy disk or over the phone, free to qualified engineers.

Five choices. Board layouts made with Quikdraw are not limited to a particular technology. Augat offers a choice of five: Wire Wrap, surface-mounted discrete wiring (Unilayer II), multilayer boards, stitch-weld, and fine-line polyimide-copper multilayer boards from the firm's Microtec subsidiary.

"In effect, the combination of the new software, low-cost work station, and interconnection data base gives the equivalent of a circuit-board foundry analogous to the silicon foundries now functioning on inputs from CAE work stations," says Larre Nelson of Augat Interconnection Systems.

Most CAE work stations have a net-

list extraction utility to define the logic interconnections for pc boards, but they do not have a tool to help with the actual physical routing of the interconnections. Quikdraw, with its software tools and data bases, supplies that missing tool. Although work-station manufacturers and their customers had sought a solution to the problem, the tool cannot be implemented without the cooperation of a factory that has the data associated with the physical implementation. In addition, most factories are not prepared to handle electronic data bases needing artwork, coding forms, and the like.

Highly productive. With the new software, Augat creates the geometries of boards, independent of the board technology and distributes them to Futurenet users in a file structure compatible with a Futurenet drawing file. These files are created directly from Augat's master files on its VAX. By using the same files for component placement, routing, and machine-drive tapes, the entire process is error-free and makes for high productivity, the company says.

The geometry files also include component symbols with the correct sizes and shapes of all popular device types. The engineer combines the component symbols and the board symbols to form an assembly drawing, which the Futurenet transmits to Augat, where the board is routed—usually within hours of receiving the data. Any computer-detected errors are reported to the customer by phone, or by leaving a file on the VAX for the customer to query remotely.

Since April, Raytheon's Equipment Division's Computer and Display Laboratory in Sudbury, Mass., has been a beta site for the new software. The division uses the Wire Wrap version of Quikdraw. At Raytheon, the new system has replaced an older in-house system based on a large mainframe.

The productivity gains were so large that Jim Taro, the Raytheon senior engineer responsible for the project, received a \$15,000 award. Several other beta sites are evaluating Wire Wrap and Unilayer versions of Augat's "pc-board foundry" software.

-Jerry Lyman



Telecommunications Engineers

HAYES... Leading A Telecommunications Revolution From Atlanta and San Francisco.

We've built a powerful engineering and technical team here at Hayes. It's been our strength and the reason for our success from the very beginning. Our focus has been on recruiting and developing the talent it takes to do more than merely compete, but to lead. The result has been a success story few in the industry can equal.

For those of you who have searched far and wide for just such an environment, where talent is provided the freedom and encouragement to grow, then perhaps it's time to take a good, hard look at Hayes, with opportunities in both San Francisco and Atlanta. There's a future in it.

- VSLI/DSP DEVELOPMENT ENGINEERS
- HARDWARE/SOFTWARE DESIGN ENGINEERS
- SOFTWARE PROGRAMMERS & ANALYSTS
- MANUFACTURING/TEST ENGINEERS
- PRODUCT DEVELOPMENT ENGINEERS
- QUALITY/RELIABILITY ENGINEERS

Interested, qualified candidates should forward a confidential resume to: **Hayes Microcomputer Products, Inc., Dept. 85-214, P.O. Box 105203, Atlanta, GA 30348.** An Equal Opportunity Employer, M/F.

Hayes®
Innovative products
for enterprising people



DON BANKARD, PROCESSING SECTION SUPERVISOR, PG&E

“ZIP+4 codes will save Pacific Gas & Electric Company \$200,000 this year.”

MAIL THIS COUPON TO SEE HOW YOUR COMPANY CAN SAVE, TOO.

PG&E was one of the first companies to convert to ZIP+4 codes—the Postal Service's 9-digit system for First-Class Mail®. Now its once-a-month mailing to 4 million customers is made at considerable savings. “About \$18,000 a month,” Mr. Bankard explained, “is purely ZIP+4 savings. That's on top of our Presort savings.”

As for the conversion, “we contracted it out. And got it done for less than expected. All the conversion costs will be paid back in only 3 months.”

Find out how the ZIP+4 program can work for you. Complete this coupon. For immediate assistance or the number of a local postal customer service representative, call 1 800 842-9000, ext. 423.

Please check your line of business:

- ☐ Insurance, ☐ Banking, ☐ Manufacturing,
☐ Securities, ☐ Utilities, ☐ Education,
☐ Retail, ☐ Government, ☐ Publishing,
☐ Service Company, ☐ Other. And check
your yearly First-Class Mail volume:
☐ Up to 10,000, ☐ 10,001-50,000, ☐ 50,001-
100,000, ☐ 100,001-1,000,000, ☐ 1,000,000+

U.S. Postal Service, Regular Mail Services
P.O. Box 2999
Washington, D.C. 20013-2999

Name

Title Company

Address

City

State ZIP



ZIP+4 ZIP+4

7K41

ADDRESSING TOMORROW TODAY.

© USPS 1984

FRESH MUSCLE FILLS GAP BETWEEN SUPERMINIS AND BIG SUPERCOMPUTERS

by Clifford Barney

NEW CLASS OF 'CRAYETTE' MINISUPERCOMPUTERS IS CHEAPER THAN THE GIANTS AND PROVIDES NEARLY THE POWER

Palo Alto

Although many sophisticated techniques have been applied to fill the gap between superminicomputers such as the Digital Equipment Corp. VAX line and the top-performance Cray supercomputers, simple brute force reaches the market first. A new class of minisupercomputers, sometimes called "Crayettes," with performance hot enough to make possible new applications in meteorology, geophysical exploration, aerodynamics, computational physics, and simulation of all kinds, is emerging as an affordable alternative to the multimillion-dollar supercomputer.

Suddenly, instead of \$5 million for a Cray X-MP, a user can choose to pay a tenth of that for a Convex Computer Corp. C-1 [*ElectronicsWeek*, Oct. 29, 1984, p. 17] which, at 60 million floating-point operations per second, performs one fourth as fast as the Cray. This still leaves even the new VAX 8600, rated at 1 to 3 megaflops, in the dust. And Convex, a Richardson, Texas, startup, is not the only firm to take advantage of this wide-open market niche.

Floating Point Systems Inc. of Beaverton, Ore., seems to have successfully made the transition from a supplier of array processors to near-supercomputer products; its FPS-264 will be the main processor for Cornell University's new supercomputing center in Ithaca, N.Y.

Proven methods. Behind Convex and Floating Point stand at least six other suppliers that will have processors on the market in the next two years. These machines have one feature in common: rather than breaking ground with innovative parallel architectures, they rely on proven processing methods and circuitry. The new class of minisupercomputers is eclipsing the hardware-accelerator and parallel-architecture approaches to high-speed computing. The former is limited in performance, and the latter, because it requires a new method of programming, is still widely regarded as developmental.

Massively parallel computing, gallium

arsenide processors, and artificial-intelligence languages may be the wave of the future, but the present seems to belong to vector processing, emitter-coupled logic, CMOS, and Fortran. ECL and CMOS provide state-of-the-art performance, Fortran gives access to a wealth of applications programs, and vector processing—the ability to compute using two-dimensional vectors instead of one-dimensional scalar values—is the hyperdrive that propels the machines close to supercomputer performance.

"It's an extremely exciting business opportunity," says Jeffrey Canin, an analyst who tracks supercomputers for Hambrecht & Quist, the San Francisco venture capital firm. "There are quite a few vendors, private and public." Canin estimates the market to be about \$125

million this year, of which half belongs to Floating Point's X64 series. But within five years, minisupercomputer sales will amount to \$1.1 billion, a lot of it stolen from the current mainframe market, Canin says.

What those users want, says Robert Schuhmann, president of Scientific Computer Systems Corp., is a general-purpose machine that runs available Fortran code at near-Cray speeds. Not surprisingly, that's what SCS has designed for introduction next spring; its machine will have one fourth the power of a Cray X-MP for under \$500,000.

Other companies in the wings include Alliant Computer Systems, Axiom Computer, American Supercomputer, and Vitesse Electronics, all startups with designs on some of Canin's billion-dollar



Defines market. Robert Schuhmann, president of Scientific Computer Systems Corp., is confident that users want a general-purpose machine that runs Fortran at near-Cray speeds.

MINI-SUPERCOMPUTERS RUSH TO FILL GAP

Market	Super mini-computers	Array processors	Super-mini-computers I	Super-mini-computers II	Mini-super-computers	Super-computers
Computation Method	Scalar	Parallel Scalar	Parallel Scalar	Parallel or Virtual Scalar	Vector	Vector
Application	General-Purpose 32-bit	Signal Processing	General-Purpose 64-bit	General-Purpose	General-Purpose Fortran	General-Purpose Fortran
Companies	DEC (VAX) Gould Perkin-Elmer Hewlett-Packard Data General IBM (4300) Prime Texas Instruments Harris	Floating Point Systems (FPS 120) CSP Star Technologies Numerix Analogic Helionetics	Elxsi Floating Point Systems (FPS 164)	Sequent Intel Hypercube Denelcor BBN Computer Flexible Computer	Convex Scientific Computer Alliant American Super-Computer	Cray ETA Systems Hitachi Fujitsu NEC

market—and some of these companies put the total figure much higher.

Next month Alliant Computer Systems Corp. is scheduled to introduce new hardware—believed to be a parallel vector processor, although the firm has so far said very little about it. A spokesman claimed “major breakthroughs” on some existing problems with parallel architectures. The product apparently will be an entire line of modular 64-bit stand-alone processors. Alliant was founded in 1982 as Dataflow Corp. by a group that had worked on the Data General Corp. Eclipse minicomputer.

Vitesse Electronics in Camarillo, Calif., will go for the best of both worlds—GaAs for component speed and vector processing for computer speed. The company plans to sell GaAs chips into the signal-processing market beginning next year, and by mid-1986 will introduce a family of superminicomputers with performance in the hundreds of megaflops range, at prices of under \$300,000.

Supports Cray. Scientific Computer Systems has what Schuhmann considers an ace in the hole: it will support the Cray operating system and run code that is binary-compatible with the 200-odd applications written for the Cray 1 over the past 10 years.

The usefulness of this compatibility, in the light of the relatively small Cray user base, is debatable. Convex marketing vice president Barry Rosenbaum counters that VAX compatibility offers access to more software, from some 20,000 users. However, Schuhmann successfully used Cray compatibility as a selling point while raising \$15 million in venture capital—enough, he says, to get the SCS machine out the door next May.

Cray says it has “arm’s length” relations with American Supercomputer Corp., SCS, and several other companies, including Convex, but no special relationship with any of them. Cray has

made its operating system available to everyone, a company spokesman notes.

Scientific Computer and American Supercomputer are the only companies to take the Cray offer to date. But while they are implementing release 1.13, Cray has already come out with release 1.14 and has 1.15 ready, says Marcelo Gumucio, Cray’s marketing vice president. The Cray 2, introduced this month, uses a Unix-based operating system.

Big comeback. Meanwhile, Floating Point, which a few years ago was staggered by the loss of General Electric Co.—its primary array-processor customer—has made an comeback with its new line of attached processors, the FPS-X64. The model 264 delivers 38 megaflops at its peak, and an average

New applications will open the market for near-supercomputers

system costs about \$750,000, says marketing manager Michael A. Tokola.

Nobel prizewinner Kenneth Wilson of Cornell, who has lobbied long and hard for federal support of supercomputing, turned to Floating Point when he got the funding he wanted. Wilson heads one of four university supercomputer centers being established with National Science Foundation funds. Two of them, at the University of Illinois and the University of California at San Diego, will be built around Crays. A third, at Princeton, will use a Cyber 205 until the gigaflop-range ETA-10 from ETA Systems is available. Wilson, however, chose to link five FPS-264s plus one FPS 164-MAX, all controlled by an IBM Corp. model 3084 mainframe.

The IBM VM operating system can be used to control the X64 machines to sim-

ulate a multiple-instruction multiple-data supercomputer. In a problem for simulating airflow over a wing, for example, VM would assign each section of the wing to a processor, and replace data statements with input/output statements at the boundaries.

Floating Point’s momentum as an array-processor vendor plus its special relationship with IBM (about half of its machines are attached to IBM mainframes) has led Canin to assign the company “pole position” in the affordable supercomputer race. But others are convinced the market will have plenty to share. “The near-supercomputer marketplace is going to explode, not only because of the price-performance ratio, but because the high performance is leading to new applications,” says Craig Ramsey of American Supercomputer.

In office computing, Ramsey explains, a payroll is a payroll and faster machines simply do the payroll faster. But in scientific computing, the bigger the machine, the better job it does. “People keep wanting more power,” Ramsey says. “The old [Floating Point] array processors used to be acceptable for medical imaging; now users want to do imaging in real time, for which they need supercomputer power.”

Everyone sees the tremendous gap between the Cray and the supermini-computer, Ramsey adds. The Linpack benchmark performed last December by Jack J. Dongarra of the Argonne, Ill., National Laboratory is in every mini-supercomputer maker’s portfolio.

In this admittedly restricted test of linear equations in 100 variables, only the Convex and the FPS 164 could approach the Cray range. The best VAX was a model 785, which took 3.01 seconds to compute what the Cray X-MP performed in 0.021 seconds, the FPS-164 in 0.264 seconds, and the Convex in 0.339 seconds. Floating Point later ran a benchmark with its FPS 264 on the same tests and reported performance equal to half that of the Cray 1.

With supercomputing receiving increased attention both inside and outside the government, Cray says it welcomes the appearance of its bargain-basement imitators. The minisupercomputer companies, Gumucio says, “will affect the supercomputer marketplace in a positive way—eventually they will create an appetite for more and more computer power.”

Cray once considered the near-supercomputer market a “quarter-horse” project. “We decided to drop it because we feel we know best how to build very large, fast, effective machines, and we didn’t want to be distracted from that,” Gumucio says. With a billion-dollar market beckoning, the others seem willing to take the chance. □

HAS THE END COME FOR EUROPEAN CHIP MAKERS?

by Kevin Smith

**THINGS ARE LOOKING BAD, AND THE ONLY CHOICE MAY BE TO
GAMBLE AND INVEST FOR A FUTURE THAT MIGHT NEVER COME**

London

When the U.S. sneezes, the rest of the world catches cold. And when U.S. chip makers take to their beds, their European counterparts fear for their very survival. Today, as perhaps the worst recession in the semiconductor industry's 40-year-old roller-coaster history washes up on Europe's shores, the question is being asked once again: do European chip makers have the strategy, the investment, and the management nerve to survive, or will their dreams of a renaissance be swept away, along with their eroded market share?

Five years ago, Europe's decline looked terminal. But since that critical low point, European chip makers have shown increasing vigor. By 1984, when the industry climbed to an all-time high, prospects never looked better. In that year, Britain's Inmos plc, which was given low odds of survival when it started up seven years ago, turned in a first profit in its sixth year of \$18.7 million on sales of \$145 million. And in the fast market for static random-access memories, it was a clear leader with a 27% share, according to market-watcher Dataquest Inc.

Italy's SGS-Ates, after a three-year overhaul by its dynamic new chairman, Pasquale Pistorio, turned in its first profit in a decade, with \$10 million of net income on \$335 million of sales, and it grew faster than the total industry. A year earlier, British gate-array pioneer Ferranti Semiconductors was ranked the fastest growing company in the industry by Dataquest.

Also in 1984, France's two chip makers, Thomson-CSF and Matra Harris Semiconducteurs SA, both made solid progress, according to Jacques Noels, general manager of the Thomson Components Group. Meanwhile, Siemens and Philips signed a groundbreaking agreement to jointly develop 1-Mb and larger dynamic RAMs, and Britain attracted its first major semiconductor startup. Newly aggressive British venture capitalists

forked out \$27 million to fund Integrated Power Semiconductors in Livingston, Scotland. Formed by the U.S. semiconductor executive David Wood, IPS will make smart power devices.

By midyear, however, the bookings peak had already crested and the industry plummeted into its worst-ever recession. Europe usually trails America by about four months, but this time the downturn came only two months later. Last week, for example, SGS laid off 1,000 assembly workers overseas, and at home it warned that it may have to put 2,000 others on short time. SGS is now running at 60% of capacity.

More headaches. When the recovery comes, Europeans will face extra problems. To start with, the industry is heading for a period of massive overcapacity. So the question looms large: can Europe rise to the challenge? "The outcome is being decided by commitments and decisions being made right now,"

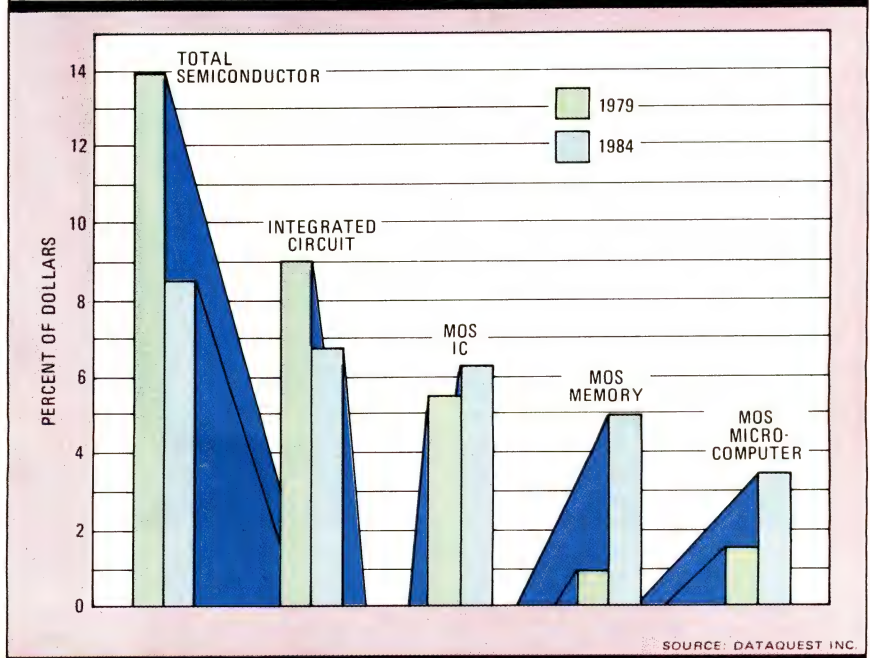
says Malcolm Penn, a London-based consultant for Dataquest.

Penn, for one, is betting on a European resurgence for many reasons. In particular, he sees Europe increasing its resolve to make its technology more competitive.

This dates back about five years. Its source was the belated realization by government and industry that chip technology was a vital strategic resource. Lengthening dole queues pointed out the decline in Europe's traditional smokestack industries.

Meanwhile, Penn says, Europe's sunrise industries have been falling behind, its consumers preferring American computers and Japanese video recorders. The prospect of sinking to Third World status has concentrated the European mind most wonderfully. The solution became clear: microelectronics was the engine driving electronics to a high-tech future when it would rank as the

SOME BRIGHT SPOTS APPEAR IN EUROPEAN WORLDWIDE MARKET SHARE



Spark of life. Although Europe has suffered an overall loss in total semiconductor market share, increases in MOS memory and microcomputers are signs of recovery.

world's second largest industry.

Government and industry laid plans to get a handle on high technology. Their strategies differ in detail but, generally speaking, there are some common strands: a quick injection of U.S. management know-how followed by a lengthier transfusion of American and Japanese technology. In the longer term, investment would be stepped up in basic research and development and in capital spending.

Meanwhile, European equipment makers, too small to compete alone, are slowly learning to collaborate, notes Thomson's Noels. ICL, Bull, Siemens, and Olivetti are collaborating on bus interfaces and local-area networks so their machines can talk to each other. Italtel, CIT Alcatel, Siemens, and Plessey are collaborating on telecommunications chips. And Europe has painstakingly hacked out a standard for broadcasting to the home by satellite [*Electronics-Week*, March 11, 1985, p. 38]. Despite these promising advances, progress is often too slow and standards are missed, as with cellular radio.

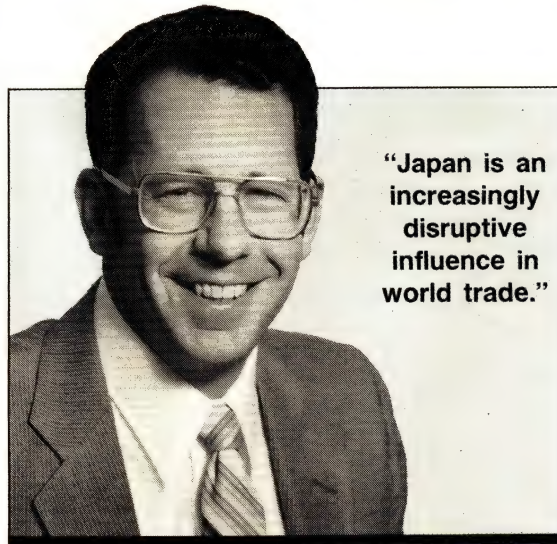
Fast growth. Led by Britain, a new entrepreneurial vigor is at last showing through. One index of an increased manufacturing activity, notes Dataquest's Penn, is that European equipment makers have enlarged their appetite for integrated circuits. Since 1982, Europe has been the fastest growing IC market in the world. In 1984, says Dataquest, shipments were up a whopping 60% in local currency or 43% in dollars, for a total of \$4.8 billion. This compares with a U.S. growth of around 53% and a world growth of 50%.

Government support for high technology is growing, too, as a series of collaborative programs—each breaking down intercompany and international barriers—get under way. Britain's Alvey fifth-generation-computer effort is up and running and will soon be followed by the European Community's more broadly based Esprit program. RACE, the European telecommunications effort, still awaits final approval, but there seems to be broad support for it. The same is true for the still-undefined Eureka program, President Mitterrand's bid to launch a pan-European high-technology research push. His original idea was to prevent too much of Europe's inventive talent getting unproductively tied up in the U.S. SDI, the so-called Star Wars program.

But as far as Europe's chip makers are concerned, there is little to show for all these efforts. According to Dataquest, Europe's share of the world chip market fell to a record low of 8.5% in 1984 and its share of its fast-growing semiconductor market dropped 8%, to 34%, in the same year.

There is disagreement as to just what these figures portend. Dataquest's Penn cautions not to be fooled by the downturn. Europe's 1984 decline, he says, could have been predicted by previous low investment. By the same token, "on investment plans and business plans now in place, European companies could regain their 1979 share of the world market—some 14%—by the end of the decade." Significantly, Europe has pushed up its share of the commodity-dominated MOS IC market in Europe from 21% to 24%.

"Nuts," said W.J. Sanders, the outspoken boss of Advanced Micro Devices Inc., at Dataquest's recent Vienna conference. "I do not agree that European



Admonishes. Dataquest senior vice president Frederick L. Zieber says Japan overinvests in semiconductor plants.

"Japan is an increasingly disruptive influence in world trade."

manufacturers will get back market share. I believe that we all will have to fight for our survival. The Japanese have won in commodity memories. My advice to Europe is don't beat a dead horse." The Japanese excel in manufacturing technology, he says. This factor, together with their lower interest rates for capital investment, lower labor rates, and government-subsidized research and development, make for an unbeatable combination in commodity products.

The way for Europe to compete, explains Sanders modestly, is by following AMD's example. The company works closely with its customers to define innovative, high-added-value products. "In memories, you can only compete on price." In a nutshell, says Sanders, Europe should make BMWs instead of Volkswagens. It is a formula that made AMD the industry's fastest-growing company last year, with sales up 85% to \$930 million.

Europe has to be in the commodity business, insists Penn. "If you opt out of every commodity sector, what is

there left?" And Penn does not believe that the application-specific IC business will provide shelter for long. "Today's high-tech part will be tomorrow's commodity product. If anybody thinks that is not going to be a cutthroat market, they are very much mistaken."

There is a fundamental manufacturing reason, widely recognized by the industry, why an ability to manufacture commodity products is important. Successful new products—such as AMD's 32-bit-slice microprocessor—can only be cast in silicon by stretching the chip maker's art to the limit.

That art is best learned by making commodity chips. Production lines can be fine-tuned while turning out the same product day in and day out. "Europe can succeed in commodities, if it goes into the business with its eyes open," says Sanders. "Intermetall's Freiburg plastic-transistor line or SGS's low-power Schottky logic line can compete on price with similar plants around the world because the right level of investments has been made." Once a process is mature, it can be used to make the value-added parts Sanders is talking about.

But there is a snag with this strategy: too many companies are playing the same game. Ever more capacity is being laid down by Japanese and startup Far East suppliers.

"Last year, five Japanese suppliers invested more in capacity than Texas Instruments," says AMD's Sanders. "Japanese industry is an increasingly disruptive influence in world trade," says Frederick L. Zieber, senior vice president of Dataquest. "It has a tendency to overinvest. It did it in textiles, steel, shipbuilding, and other manufacturing, and it is now doing the same in semiconductor manufacturing."

"The sentiment for protectionism is rising rapidly. Without substantive measures by Japan and the Common Market, I can assure you that the status quo is going to change." It is inevitable that wealth will transfer from the developed West to the developing nations, Sanders observes, but this has to be done in a manageable way to avoid too much social upheaval.

With its mounting unemployment, Western Europe is already experiencing this disruption. And its chip makers are in the front line. Their dilemma: they give the game away if they do not participate, and they risk losing their shirts by joining in. □

HIGH-DEFINITION TV WAITS IN WINGS FOR DEMAND TO BUILD

by David M. Weber

**MANUFACTURERS HAVE PROTOTYPES, BUT SEEK GO-AHEAD FROM
BROADCASTERS BEFORE TRYING TO INTEREST THE PUBLIC**

Chicago

We're ready to move on high-definition television; the product is on the shelf, and when the broadcasters say 'go,' we'll be there." That, at least, is the intent of Kenneth R. Wipfler, special accounts sales manager for Sharp Electronics Corp.'s Consumer Electronics Division. But the question of when TV broadcasters might commit themselves to an entirely new standard—even partially—remains very much open.

"The motivation of the broadcast industry is low right now," says Kent Hammond, national merchandising manager of the Video Group for Sanyo Electric Co. In Hammond's view, no one needs HDTV because the consumers are essentially satisfied with the quality of the TV picture they're getting.

Indeed, the consensus at the Summer Consumer Electronics Show, held here earlier this month, was that when consumers complain about the quality of an image from a standard, good-quality TV set that is properly tuned, the complaints concern broadcast and reception flaws—such as ghosting and weak signals—rather than color fidelity and picture definition.

"A lot of sorting out [of new TV technology] has to happen in America before any TV maker deviates too much from the present format," Hammond says. "Look at stereo TV broadcasting. What's happening with that? Not much."

Accordingly, Sanyo is expanding its line of standard receivers and equipping even the low-end models with technology that has been available since the beginning of this decade: broad-bandwidth capability (to process between 3.5 and 5 MHz of the broadcast color spectrum), and comb filters to separate the luminance and chrominance components of the TV signal.

"These are devices that make a difference in the quality of what the consumer can see in a normal broadcast picture," says Hammond, "and they're

cheap enough now for us to start to offer them throughout our line."

Many intermediate technologies can be exploited on the way to consumer acceptance of HDTV; that is Sanyo's strategy for eventually achieving that acceptance. The most important of these technologies is the incorporation of digital chip sets into a modification of its existing NTSC chassis by late 1986. But Sanyo's main purpose in offering digital receivers is to eliminate ghosts and other flaws in TV reception, and only secondarily to provide such features as a second program within the main picture [*ElectronicsWeek*, Aug. 13, 1984, p. 49].

Plans deferred. Hitachi Ltd. had a prominent HDTV exhibit at the National Association of Broadcasters meeting in Las Vegas this spring [*ElectronicsWeek*, April 22, 1985, p. 19] but canceled plans to show an HDTV at CES because the company does not see a big enough market for it in the consumer sector—at least not now. "It's a question of money," says Tee Yakura, product manager

of Hitachi's Specialty Products Division. "Will consumers pay up to double the price [of a high-end standard receiver] to get a sharper picture? Probably not."

However, Yakura does foresee that one potential HDTV broadcaster will not necessarily wait for compatible receivers to come down in price before beginning trial runs. "NHK [Japan Broadcasting Corp.] will force the standard [1,125 lines, 5:3 aspect ratio] that the U.S. and Japan have already agreed to. They'll just go ahead and do it," predicts Yakura. "The receivers can come later."

And, in Hitachi's view, once HDTV receivers are built in quantity, their price will drop. Hastening the eventual acceptance of the receivers is the fact that they can be marketed anywhere in the world without modification, because HDTV broadcasts will probably use a single worldwide standard.

Toshiba Corp., one of the two manufacturers to exhibit high-definition equipment at CES (the other one was



Large prototype. The technology for high-definition TV is here, and consumers seem curious, but no set maker plans to start selling to them before broadcasters make a commitment.



Adequate equipment. Consumers appear to be satisfied with the picture quality of the new digital and RGB monitors now available, blunting the demand for high-definition TV.

Sharp Electronics Corp.), was also not planning any new product introductions despite the prominence of its HDTV prototype at the show. "What we're showing is the capability of our technology," stresses Richard J. Meidenbauer, marketing manager for Toshiba's Consumer Products Division. Although he admits that HDTV is not in the cards yet, he predicts that "the technology for it will spill over into more immediate product introductions."

Picture tubes are one example. To create a tube for a 40-in.-diameter HDTV, Toshiba developed a large-caliber (12-mm) electronic gun that reduces the diameter of electronic beams to approximately one half the size of those produced by conventional (9.5-mm) guns, improving TV image focus.

Other developments include a new fluorescent material for higher color purity, a dynamic focusing circuit for independent focusing at each point on the screen, and a digital convergence circuit to automatically adjust the matching of basic colors as they intersect to improve color fidelity. "These developments

are also being incorporated into our new high-end standard receivers," says Meidenbauer.

One HDTV product that does not involve broadcasting is JVC's new still-image disk recorder that uses a grooveless capacitance pickup similar to the Video High Density disk player, Matsushita Electric Industrial Co.'s and General Electric Co.'s cooperative (but abortive) attempt to provide a lower-cost alternative to laser-disk players.

In a resurrection of the technology,



Taped programs. HDTV pictures are stored on 1-in. tape, but no broadcasts have begun. One market, however, may be in industrial presentations.

JVC is now cooperating with NHK to reproduce a still video image that uses a high-definition disk and still-image adapter. Signals are read by a noncontact electrocapacitive stylus that glides over the disk surface, transmitting information at 5,733,000 b/s. The picture coding occurs at the NTSC (and HDTV) 60-Hz line rate, which translates in this scheme to 15 seconds/frame. The disk can store 480 images, with accompanying two-channel digital audio.

John Igawa, vice president of JVC's Consumer Division, sees the product (tentatively designated AHD/VHD—for audio/video high density—during its introduction in Japan) as best suited for the professional market. "We have no firm plans to release it to consumers," Igawa says.

On the air. That NHK is involved in still video, however, could point to a more concrete commitment from the Japanese broadcasting giant to start sending HDTV signals over the air. Though there are no rumors of impending commercial broadcasts, NHK sees a limited application for HDTV in video conferencing and in long-distance transmission of high-quality images—for the medical community, for example.

Such transmissions would probably use the wide-bandwidth capabilities of direct-broadcast satellites. Hans Ginér, president of Sweden's Luxor Industri AB, expects to be promoting his firm's ability to offer a range of DBS services in Europe by the end of next year. "And when the EBU [European Broadcast Union] gives its okay for HDTV, we'll be there," says Ginér. Yet he remains cautious about predicting a date for even private HDTV transmission in Europe, because the EBU—unlike Japanese and U.S. broadcasters—has yet to approve the proposed world standard.

Ginér's readiness to jump on the HDTV bandwagon is echoed by Kenneth Wipfler. "Sharp is showing an HDTV monitor [at CES] because we want to show off the \$1 million-a-day we're spending on research and development," he explains. "It doesn't matter that the broadcasters are holding back; we'll move when NHK gives the word. Until then, we just want the world to know what we can do."

For now, though, it's a safe bet that neither NHK nor any other commercial broadcaster will start fueling a demand for HDTV receivers. Indeed, the biggest obstacle facing HDTV may be the adequacy (in consumers' minds) of the current technology. An NEC sales representative, who requested anonymity, said, "We hear plenty about plans and prototypes, but no one's talking sales. When my dealers ask me about promoting a sharp picture, all I know is 'comb filter, 330 lines, end of story.'" □

**THE AT&T PC.
THE COMPUTER WITH
THE FUTURE BUILT IN.**

Before you buy a personal computer for your business you should ask yourself two essential questions. One: What do you need today? Two: What will you need tomorrow?

The AT&T PC 6300 is the answer to both. Today, you'll get a high performance computer that's competitively priced. A computer that not only runs the broadest selection of software available, but has the power and speed to make the most of it. A computer with superb graphics in monochrome or color. And a high resolution screen that's easy on the eyes.

For tomorrow, you'll get a computer with the future built in. With its modular architecture and seven expansion



sion slots, it's ready now to work with future technology, and meet your future needs. From additional power to multi-tasking capabilities, even to features yet to come, it can be easily enhanced as time goes by.

That's a commitment from AT&T. And the AT&T PC, the computer with the future built in.

For more information, call your AT&T Account Executive, visit an authorized AT&T dealer, or call 1-800-247-1212.



AT&T

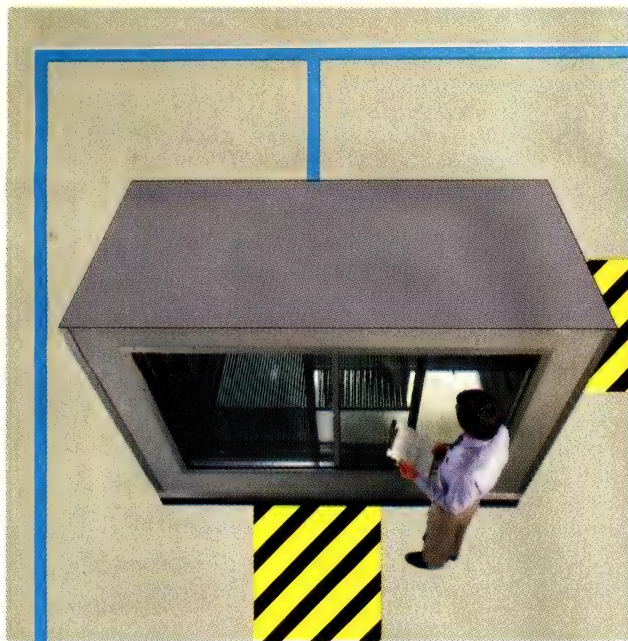
The right choice.

HOW TO TEST THE PRODUCTS OF THE FUTURE. IN THE FACTORY OF THE PRESENT.



Like all Zehntel in-circuit testers, the Zehntel 850™ gives you non-multiplexed architecture with the power of UNIX™. And Zehntel software offers the fastest test generation and debug available today.

Zehntel's Aerotronic environmental stress and test systems virtually eliminate field failures, while reducing burn-in time from several days to just a few hours. Dramatically reducing work-in-process inventory and field warranty costs. The Aerotronic 1200 Fixtured Cart System can process over 500 boards per batch.



Zehntel's Columbia 2000 Performance Test System uses bus timing emulation to provide real-time functional testing of VLSI microprocessor boards at a minimal price. The Columbia 2000 delivers exceptional fault coverage, fast programming and debug, plus real-time diagnostics.



The UNIX-based Zehntel 700™ Net Workstation is the information hub of your test floor. Computer-aided repair speeds the board rework process. Program management insures correct revision test programs. And production reporting tracks product yields and fault counts while providing alarms for real-time feedback on process problems.

Face it.

The earlier you find failures in your printed circuit board production test process, the more you save.

In time. Money. And work-in-process inventory.

And with the complexity of the new boards coming out of design today, those failures are becoming harder and harder to find.

Which is why you need a comprehensive set of subassembly test and information tools that all work together. And are as advanced as the products you're getting ready to build.

Automated in-circuit testers to pinpoint process and component failures.

An integrated information system that captures failure rate data and turns it into process improvements. To eliminate repeated problems. In real time.

An environmental stress and test system that reveals product weaknesses before they turn into warranty expenses. And a performance test system that eliminates the high cost and inefficiency of yesterday's "hot bed" testers.

Today, only Zehntel delivers this total subassembly solution.

All our test and information systems feature open architecture and modular design, which make them very easy to operate and upgrade.

And our expert consultants are ready to design solutions based on the realities of your factory floor. So call today for details and product information. 800-HLP-TEAM. You'll see how advanced the factory of the present can be.

Mention this ad to receive your free copy of the informative new book, "Strategies for Electronics Production and Test."

Zehntel, Inc., 1600 South Main, Suite 320, Walnut Creek, CA 94596 (415) 946-0400

Zehntel®

COMPAQ could have stopped here



...but we didn't.

Introducing the new COMPAQ DESKPRO 286™. More features, more speed, more power.

Most people think the IBM® Personal Computer-AT™ holds the records for speed, memory, and storage. But now COMPAQ® has created a personal computer that pushes the technology much further.

A faster computer

Most computer companies would have been satisfied with a computer that ran programs as fast as the IBM PC-AT. But not COMPAQ. The new COMPAQ DESKPRO 286 runs all the popular programs 30% faster.

Work alone or network

Most would have been content with 3 Megabytes of memory, the IBM PC-AT's maximum. But again, not COMPAQ. The COMPAQ DESKPRO 286 can expand to 8.2 Megabytes.

And most would have been comfortable with 40 Megabytes of storage, the IBM PC-AT's maximum. But we designed the COMPAQ DESKPRO 286 to expand up to 70 Megabytes so it can become a faster, more powerful network file server.

Like the IBM PC-AT, COMPAQ offers 360-K byte and high-capacity 1.2-Megabyte diskette drives. But

we didn't stop there. We offer you more. Like the *internal* fixed disk drive back-up system pioneered by COMPAQ, to protect all the data on your 20-, 30-, or 70-Megabyte fixed disk drive system. There's room to accommodate up to four storage devices.

No compromises

The COMPAQ DESKPRO 286 offers a monitor that displays both high-resolution text *and* graphics. To get the same feature with the IBM PC-AT, you'd have to pay considerably more.

In short, with the COMPAQ DESKPRO 286, you don't get compromises. Just a more powerful, more advanced, more complete personal computer for anyone who demands the utmost in performance.

And if you need all this power to go, we also offer it in a package half the size of an IBM PC-AT, complete with a handle. It's called the COMPAQ PORTABLE 286™.

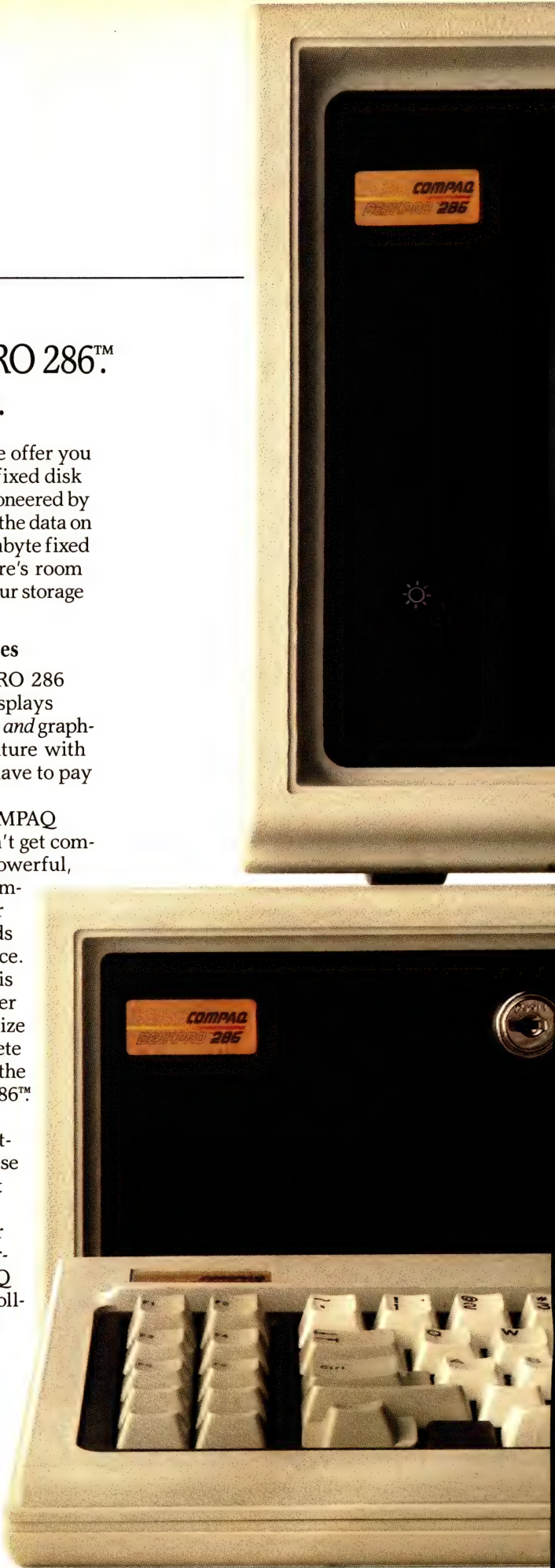
Portable or desktop, COMPAQ offers computers without equal. Because we design them without compromise.

For a free brochure or the location of your nearest Authorized COMPAQ Computer Dealer, call toll-free 1-800-231-0900 and ask for operator 7.



It simply works better.

COMPAQ
DESKPRO 286™



THINKING SMALL AT WAFERSCALE INTEGRATION

Company uses cell library and building-block approach to develop more practical system-on-a-chip integration

Fremont, Calif.

If "wafer-scale" describes ambitious wafer-wide silicon systems, then Waferscale Integration Inc. is misnamed. This semicustom startup is starting small, with a system on a normal size chip. But its unique variable-size cell library permits a building-block approach to higher and higher levels of integration.

"The 6-in. wafer with random logic is a nonevent," says Waferscale Integration cofounder and vice president Terry Leeder. "Those programs are only good for Cray-type systems, where you might sell 50 wafers a year," he adds, referring to the supercomputers manufactured by Cray Research Inc.

Turning a wafer into a megasize chip is a still-unachieved technical feat. The most recent failure was experienced by Trilogy Systems Corp., the firm started by computer pioneer Gene Amdahl, which had to back away from its idea of putting an entire mainframe on a wafer. Waferscale Integration is going the other way, starting small and making ever more complex cells available so that more and more of a system can be pulled onto a chip built with state-of-the-art technology. The company says it can already put a 50,000-gate system on a 300-mil² chip.

The firm uses 2- μ m CMOS, which it says will be scalable without changes to 1.5- μ m design rules. Its cell library is built around CMOS versions of the pervasive 2901 bit-slice bipolar microprocessor family from Advanced Micro Devices Inc., and includes random-access memory, nearly 100 medium scale integration circuit functions, and a new wrinkle—erasable programmable read-only memories to let designers change microcode on the fly.

Waferscale Integration's newest cell incorporates an entire 32-bit microprocessor with subnanosecond gate delays. It contains eight 2901C 4-bit bit-slice processors and three carry/lookahead units. The cell operates at 15 MHz. It can be

combined with the cells from the rest of the library to build a system replacing nearly a dozen discrete bipolar integrated circuits, the company says.

Waferscale Integration was formed less than two years ago by three executives from Synertek Inc. who left before the collapse of the video-game ROM market sank that once-prosperous Santa Clara, Calif., chip vendor. (Synertek gave up the ghost last December after trying futilely to switch to the application-specific IC market.)

Synertek was a victim of immature technology, Leeder now says. "The cell library had 3-to-5- μ m design rules," he explains. "We could see what a cell-library approach would do against gate arrays, but we were limited by Syner-

tek's stone-age cell-library process."

The arrival of the appropriate cell-library technology has the standard-cell market poised for explosive growth. Gnostic Concepts Inc., the San Mateo, Calif., market research firm, pegs the overall standard-cell market at \$573 million this year, up from last year's \$461 million. By 1988, the market should exceed \$1.1 billion, it estimates. Of the total market, CMOS technology will have the highest growth rate, notes analyst Mary Wu, with a 51% compound growth rate versus a 17% rate for bipolar technology. The compound annual growth rate for n-MOS is 20%, she adds.

Bipolar to suffer. Some of that growth will come at the expense of the slow end of the bipolar emitter-coupled logic market. Bipolar suppliers can make ECL faster, but the CMOS circuits maintain advantages in low power and very large-scale integration.

"The key element is the CAD [computer-aided design] tools," says Andrew Prophet, a market analyst with Dataquest Inc., a San Jose, Calif., research firm that puts the standard-cell market at about \$100 million this year, growing to \$2.5 billion by 1989. "If they really catch on, this market will take off. The companies that can pull together the proper CAD tools and build service organizations [to assist in customer design] will succeed," he says.

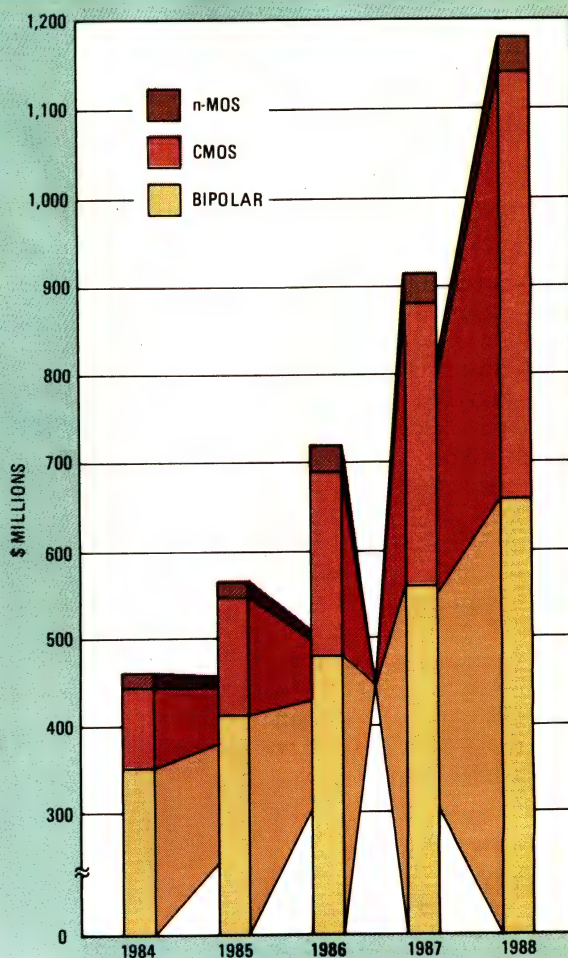
Waferscale Integration supports the work-station products offered by Daisy Systems Corp. and the CAD software developed by P-CAD Inc., for the IBM Corp. Personal Computer AT, as well as the Digital Equipment Corp. VAX. It is currently working on an implementation for Mentor Graphics Corp.'s work station.

Adapting software to a work station is not a trivial effort, Leeder says, because of the complexity of the logic simulator. Waferscale Integration picked Daisy and Mentor because it owns 80% of the work-station market, and P-CAD because the IBM PC is becoming a generic piece of hardware that an engineer can justify purchasing because it will do a lot more than CAD.

"For every cell, we have to do three simulators," Leeder says, adding that the burden of supporting so much equipment is taxing on a startup.

To establish the customer-support service, a three-year program is under way. By 1988, the company wants 90%

STANDARD CELLS: CMOS WILL LEAD IN MARKET GROWTH



SOURCE: GNOSTIC CONCEPTS INC.

of its chips designed by the customer and only 10% designed in house, says marketing director Dale Prull. At present, with the support network just taking shape, the proportions are reversed. One regional business unit, for design, marketing, and applications support, opened in Santa Clara last November, and another is scheduled to open in Concord, Mass., in July. Waferscale Integration also works through Diplomat distributor centers in northern and southern California, Minneapolis, and Long Island, N.Y.

Strategic task. Software and support are tactics; the strategic task is educating the customers. "Essentially, we need to commercialize the technology," says cofounder and president, Eli Harari, who developed CMOS and bipolar EPROM processes in the mid-1970s at Hughes Aircraft Co.

"We have a two-pronged strategy," Harari continues. "At this stage we are working with relatively low-volume prototypes and emphasizing very fast turnaround." (The firm now promises a 10-week design-to-prototype cycle. Its new 32-bit microprocessor cell took just nine weeks from logic simulation to prototypes.)

In the longer term, which in the fast-lane application-specific IC world means about 18 months, Harari says that the company will install its own prototype line and work out agreements with a Japanese ally for high-volume production.

The Japanese alliance means Waferscale Integration must make separate arrangements for the military, which Harari says will become a significant part of the customer base. "Military customers are developing next-generation systems and their requirements lead by two to three years what we see on the commercial side."

Current applications for the firm's circuits include high-speed data communication, graphics, floating-point processing, signal processing, networks, and high-speed computer peripherals, all areas where CMOS has caught TTL and is chasing ECL, and where the AMD 2901 family reigns supreme.

"AMD definitely built the market," Leeder says. "But it never seriously thought of CMOS." (However, AMD has an agreement with LSI Logic Inc., one of Waferscale's rivals, to make a 2901 cell the core of an LSI Logic array. In addition, General Electric Co.'s Custom

IC operation has a bit-slice 2901 cell that is similar to Waferscale's version.)

Harari looks to EPROM technology to give his firm a technical lead. "We believe that the future for system integration on a chip will involve not just integration of logic gates, but also of software, meaning firmware," he says.

Sophisticated. "We are working on systems that entail the integration of an operating system with very sophisticated central processing units," he continues. "The importance is that as you look into distributed systems, parallel processing, systolic arrays, and fifth-generation computing requirements, you will see that you cannot distribute your hardware and keep your software centralized; you will have to distribute the software, too."

Customizing on the microcode level, Harari adds, will give designers a significant competitive advantage. Essentially, he says, "we can give you a raw CPU element, and you can write your own instruction set."

As a spinoff from the EPROM technology, the company has developed a standard product, billing it the smallest



Convinced. "The 6-in. wafer with random logic is a nonevent," says Waferscale Integration Inc. cofounder Terry Leeder.

and fastest 64-K EPROM in the world. Within the next six months it will market 128-K and 256-K versions.

Waferscale Integration has raised \$24.55 million in two rounds of capitalization. In 15 months, it has built a staff of 80, developed design rules, and purchased equipment. It will ship its first product—a 16-bit graphics processor CPU—this quarter, as well as the EPROM, which was to be out in March but the technology proved a little more difficult than the company expected. Otherwise, Leeder says, "We are on track."

—Clifford Barney

BOTTOM LINES

R&D spending up 11.5% in 1984

Research and development spending by the 100 largest U.S. industrial companies rose 11.5% last year to a record \$35.8 billion from 1983's \$32.1 billion, according to the 10th annual survey conducted by Technical Insights Inc., publisher of *Inside R&D*. "As to 1985, our preliminary estimate of company-sponsored R&D spending, based on first-quarter results of 22 companies listed in the top 100 spenders, indicates we may see an 11.7% increase in R&D spending this year," a spokesman says. Among the survey's findings is that R&D spending as a percentage of sales averaged 5.2% for the 100 companies versus 5.06% in 1983, and R&D dollars spent per employee in 1984 averaged \$4,987 compared with \$4,500 the year before.

IBM Corp., whose spending rose 25.2% in 1984 to \$3.148 billion, edged past General Motors Corp. for the No. 1 position in R&D expenditures. GM's spending rose 18.2% to \$3.076 billion. Third was AT&T Co., with a spending gain of 6.6% to \$2.368 billion. Other electronics companies in the top 10 were: General Electric Co. in sixth place, with spending of \$1.038 billion; United Technologies Corp., seventh with \$1.012 billion; ITT Corp., eighth with \$974 million; and Eastman Kodak Co., ninth with \$838 million.

Enmasse gets more funding

Enmasse Computer Corp., the Acton, Mass., developer of expandable computer systems for the commercial transaction-processing market, received \$7.56 million in a second round of venture financing. The company raised \$3.5 million in a first round of venture financing in October 1983.

Motorola acquires automation firm

Motorola Inc., Schaumburg, Ill., has acquired Phase 2 Automation of Palo Alto. Terms were not disclosed. According to Motorola, the privately held Phase 2 produces automated material-handling systems for the hard-disk-media industry. Phase 2, it said, will become part of Motorola's New Enterprises organization, which is designed to build "completely new businesses for Motorola in emerging high-growth, high-technology industries."

Chip-equipment maker raises cash

Ateq Corp., a semiconductor-process-equipment manufacturer based in Beaverton, Ore., announced that it raised \$6.8 million in a second round of venture financing. The company, which plans to introduce its first product later this year, has raised a total of \$10.3 million so far.

BELL ISSUES CHALLENGE TO COMPUTER MAKERS

Wellesley, Mass.

His advance billing was impressive: "Talking to Gordon Bell is like listening to 20 radio stations at once." "Bring two notebooks, because you're going to have to write with two hands." "Gordon Bell time-shares his mind."

His advance billing is accurate. The 50-year-old vice chairman of Encore Computer Corp. tends to speak in flurries of incomplete sentences and tangential thoughts. But he also makes some direct, bold statements.

"We're going to take on the minis and the mainframes and really beat them," says Bell. "This is the way computers will be built."

Those assertions refer to his two-year-old company's plans to market—in about a year and for the price of a Digital Equipment Corp. VAX 8600—a general-purpose superminicomputer capable of executing 50 million instructions per second. Even sooner, he says, Encore will have a 15-mips system.

Competitive edge. The "way" Bell speaks of involves the use of multiple processors. Though scores of others are taking the same path, Bell has an edge shared by few: he actually has been responsible for the way many computers are built.

A former vice president of engineering at DEC, he led its development of the first commercial time-sharing computer and was later responsible for the VAX 32-bit superminicomputers. *Computer Structures*, a textbook he co-wrote, is cited as an inspiration by Dave Nelson, vice president of Apollo Computer Inc. and designer of that company's successful virtual-memory system.

One of Bell's passions over the past 25 years has been for the potential of multiprocessors. Unlike multicomputers, which Bell believes will serve only limited applications, multiprocessors are organized around a single, uniform bus connecting central processing units, input/output processors, and—Bell particularly emphasizes this—common memory. Though each processor also requires its own cache memory, he says that in a multiprocessor, "You want any processor to access any part of memory."

Bell compares the Encore architecture to a cube, one that can be partitioned into independent computers, using com-

mon memory for intercommunication. Extremely flexible, it will be able to operate on many different programs in parallel. "We wanted to support time-



Driving force. Encore's Gordon Bell has influenced the development of many computer systems.

sharing and evolve to true general-purpose parallel processing," he says.

The computer now under development at Encore represents his eighth multiprocessor system, but Bell says it is the first that is cost effective. What makes multiprocessors commercially viable now is a lower bus-structure cost and the greater availability of high-quality general-pur-

pose microprocessors.

"The microprocessors force us to do it right. They permit us to put a number of microprocessors on a card and almost treat them like memory chips."

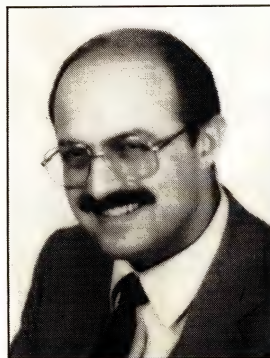
But Bell complains, "It's taken so incredibly long to produce good chips [the first processor on a chip was built in 1971]. If I have one complaint to the whole world right now it is, 'For God's sake, build some good micros.' I want a decent memory-management system, I want floating point, I want large addresses. Our whole life depends on getting those chips." —Craig D. Rose

JACOEL, PICKED BY WORKERS, TURNS COMPANY AROUND

Selvazzano Dentro, Italy

Since he just managed their company to its first profit in several years, Rafael Jacoel may ask his employees

for a raise. As managing director of Zetronic SpA, a small company based in this northeastern Italian town that now makes a large part of its income making and selling sockets, connectors, and heat sinks to electronics firms, Jacoel is in a peculiar position.



In 1978, the owners of Zetronic, then a company using metal-blanking techniques to produce such simple articles as snap buttons and rivets, decided after nearly a decade of deteriorating performance that the position of the firm was hopeless. Consequently, they dismissed all 800 workers.

Extraordinarily, however, because the employees saw little possibility of finding new jobs in the underdeveloped area around Padua, they kept on working. Soon the government stepped in, providing the financial support that allowed them to form a cooperative to take over the company. The new owners—that is, the employees—brought in professional managers, Jacoel among them, to run it.

The employees chose Jacoel because they felt his prior experience as director of diversification for the Italian operation of the Singer Sewing Machine Co. made him particularly well qualified. Under the agreement made between him and the company, Jacoel directs the day-to-day operations of Zetronic, but during board meetings he has to answer to his own employees.

"In normal operation, I give the orders and run the company like any other managing director," Jacoel explains. "But when we have a board meeting, I have to justify my actions and their consequences to the owners, who are also my employees. The funny thing is that for them to attend the board meetings, I have to sign a pass giving them permission to be absent from work."

Profitable. Last year, Jacoel led Zetronic to a modest profit of just over \$100,000 on sales of \$115 million. That was the first time the company was in the black since the employees, now numbering about 400 because of natural attrition, assumed control. The main reason for the firm's turnaround is a diversification strategy that made it mainly a supplier to the electronics industry.

"We had equipment and expertise in a number of traditional manufacturing areas like metal blanking, plating, and electrochemical treatment of surfaces. Our basic decision was [to use] those same technologies to manufacture products that were used in the production of electronic components and equipment."

Zetronic now supplies integrated-circuit sockets, lead frames, and heat sinks worldwide to companies like Motorola, Texas Instruments, and RCA, as well as to compatriot SGS-Ates. The company also recently developed a board-mounted connector for securing ribbon cables to printed-circuit boards.—Robert T. Gallagher

Boss? Chosen by his own workers to manage Zetronic, Rafael Jacoel must answer to them at board meetings.

AHH. IT'S LONELY AT THE TOP.

TWA's FIRST CLASS SLEEPER-SEATSM TO EUROPE
AND THE AMERICAN EXPRESS[®] CARD PUT YOU
COMFORTABLY AHEAD OF THE CROWD.

Success has its rewards. And TWA's First Class and the American Express Card are two rather impressive examples.

In TWA's First Class you can select from a menu that includes caviar and champagne. Entrees like chateaubriand. And vintage wines like Puligny-Montrachet.

Then stretch out comfortably in a Sleeper-Seat, and sleep the flight away.

And as a First Class passenger, you'll be treated accordingly from the moment you first reach the airport. With a separate check-in desk for your convenience. And a special invitation to relax in TWA's Ambassadors Club[®] lounge before your flight.

And when you take the American Express Card along, you have an ideal travelling companion. Because it's known and welcomed all over the world.

So you can use it to pay for your TWA tickets, your hotel, rental car, meals — or just about anything else that strikes your fancy along the way.

And of course, when you carry the American Express Card, you carry all the cachet that comes with it. Don't leave home without it.[®]

And do take TWA's First Class on your next trip to Europe. It's in a class by itself.



LEADING THE WAY. TWA.SM

Millions upon millions of CTS Automotive Sensors are on the road today!



—providing precise, highly reliable signal output for continuous electronic control of automotive functions

It's not surprising that CTS Automotive Sensors are in daily service on millions of vehicles. Demanding automotive engineers have learned that CTS delivers what they need in these difficult competitive times.

CTS knows automotive problems. We have been intimately involved in electronic automotive components for over 30 years. Current work with major auto firms involves development of the most advanced sensors and actuators for EGR valve position, throttle position, cruise control, transmission control and engine RPM applications. *Broad ranging technology* includes variable resistors that

provide voltage output-to sensors with magnetic pickups to deliver pulse rate signals. CTS is a "single source" with multi-plant capability. Dependable, on-time delivery is assured because CTS literally "second-sources" itself. With eight automotive product plants here and in Canada as well as added worldwide facilities, CTS is a true "world car" electronic components supplier.

Write today for our "Automotive Electronic Capability" folder. Contact: CTS Corporation, 905 N. West Boulevard, Elkhart, IN 46514. Phone: (219) 293-7511.



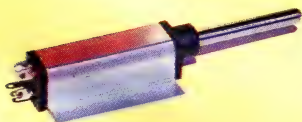
Consistently high reliability... at competitive prices

These CTS linear and rotary throttle position sensors are presently in use by the major automotive companies. Product quality and precise performance have exceeded their expectations. And price is extremely competitive.

CIRCLE NO. 46

CTS means Reliability

CTS CORPORATION • ELKHART, INDIANA



General purpose
linear position sensor



Specialized diesel
engine sensor



EGR valve sensor



Engine RPM sensor

SLOW AND STEADY IS THE NEW STRATEGY IN AUTOMOTIVE ELECTRONICS

by David M. Weber

ELECTRONICS FIRMS WANT TO PRESS AHEAD, BUT CAR MAKERS ARE MOVING MORE CAUTIOUSLY

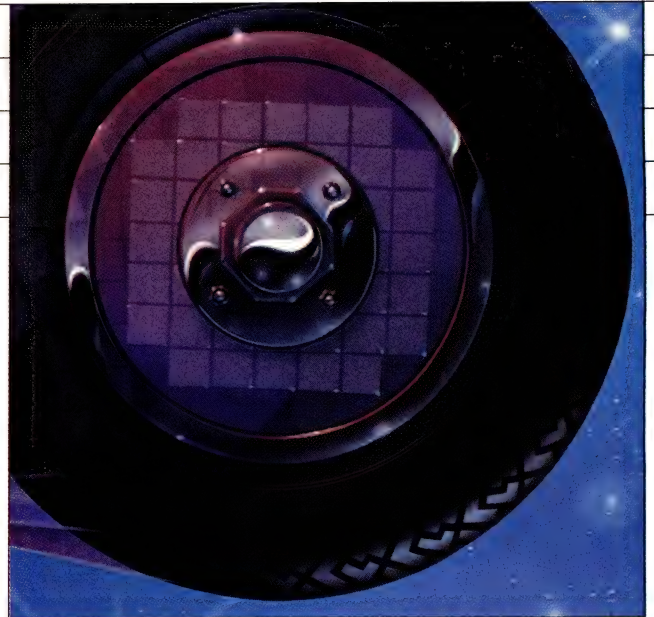
The current wisdom among electronics producers is that automakers will continue to use electronic components as much to boost performance as to appeal to consumers with their high-tech looks. Such exotic systems as radar guidance, terrain-mapping vehicle locators, and collision-avoidance systems have proven to be as-yet-unrealized dreams. But the auto industry's record in delivering other long-promised features for safety, entertainment, comfort, and energy conservation over the last decade has been fairly credible. And, some say, the growing number of electronic components finding their way into cars means a bonanza for component vendors.

There are many ways to measure the dollar value of the electronics used in automobiles, and some can be misleading. Even the most straightforward—adding up the cost of microprocessor-controlled automotive components—is subject to interpretation. The usual auto industry figures give an average of \$500 for the worth of non-entertainment electronics in a U.S.-built 1985 car—10 times more than in 1970, and a third of the predicted value for model-year 2000. But before rushing to build more capacity, semiconductor manufacturers should know that such figures really represent the total cost for whole subassemblies—for example, an electronic ignition system with spark plugs and wires, rather than just semiconductors. Thus, according to another reckoning, the total value for all the semiconductors in an average new car is only \$64, and will go to just \$150 by the year 2000.

Still, automakers say consumers measure an automobile's "newness" by what kind of functions it has under the hood and inside the passenger compartment, and less by its exterior design. This is good news for the electronics industry. Car makers will be buying \$6 billion worth of electronics gear this year, going to \$14 billion by 1990, worldwide. Although such figures seem promising, it is useful to step back a bit to examine exactly what kind of electronic equipment can be economically manufactured, and whether it offers advantages that consumers (hence automakers) will pay for.

One company that successfully entered the arena is Intel Corp., which made its commitment to automotive electronics beginning with the 1978 Cadillac Seville. The Seville used a precursor of the company's MCS48 8-bit microcontroller for an electronic instrument display. Since then, such displays have become more common, chiefly because they appeal to the consumer with their high-tech looks. (Fig. 1) But the more important aspect of automotive electronics in terms of its potential value to both electronics suppliers and the consumer has to do with how a car performs.

"Power-train electronics controls are the largest segment of the automotive semiconductor market and have led the way for the integration of the microcontroller across the board in all vehicles," contends Fred Phail, marketing manager of In-



tel's automotive group. "And in light of federal emission and fuel-economy standards, automakers have been forced to look to electronics to supply the needed punch that their new, lower-horsepower engines lack." Fuel injection, for example, which results in a more precise mixture of fuel and air, was once a premium feature reserved for high-performance and luxury cars. But electronics have made it possible to manipulate solenoid-controlled injectors at much lower cost, and it is increasingly becoming an industry standard.

Electronically controlled ignition systems also improve economy and performance by ensuring that each spark plug is fired at the optimal stage of the piston stroke. A digital timer monitors speed, temperature, and engine load, and an additional sensor picks up predetonation (knocking) in the cylinder. The correlation of these functions depends on real-time computations, which must occur at greater speeds as new functions are added.

Phail sees integration of the different aspects of engine and power-train control as the biggest automotive challenge. To fill this need, Intel is pushing its MCS-96 family of 16-bit microprocessors for automotive systems that need frequent responses, or need to integrate functions like spark, mixture, and transmission control. Packaged on a single chip, they offer an instruction set that can be tailored to the options an automaker might offer, such as electronically controlled transmissions that let a driver select operating modes based on traffic conditions or personal preference.

Jack Stewart, director of strategic marketing for automotive applications at Motorola Inc. in Phoenix, Ariz., says that the company's new MPC 1500 Smartpower switch represents a major step along the road to integrating electronic functions. The switch's role is to regulate the power at the interface between the logic level of a microprocessor and an automotive device like a light, horn, or dc motor. If a malfunction occurs at the device end, the microprocessor can alert the driver through whatever electronic display the car happens to



1. New look. In growing numbers, consumers judge new-model automobiles by the look of their instrumentation. The high-speed switching liquid-crystal display manufactured by Asahi Glass Co. in Japan is typical of the high-tech look and multifunction capabilities that consumers are clamoring for.

a customer can specify from the ground up. The Intel 8061, for example, is being custom designed by Ford to integrate sensor data by means of a multiplexed wiring scheme that will serve both control and display functions, and should find its way into Ford cars before the end of the decade.

For the period between now and 1990, Intel's semicustom processor (yet unnamed) will be marketed to automakers

who seek to integrate a car's functions without necessarily resorting to multiplex wiring. And at the low end, Intel's standard, noncustom automotive chip, the 8051, will continue to handle the dashboard display and simple engine control.

Motorola's approach is similar. For the present, the company is promoting its MC68HC11, an 8-bit CMOS processor with 16-bit-wide registers to integrate engine, power-train, and information-display functions. But within a few years, Stewart expects that such standard 8-bit machines will give way to 16-bit full-custom devices.

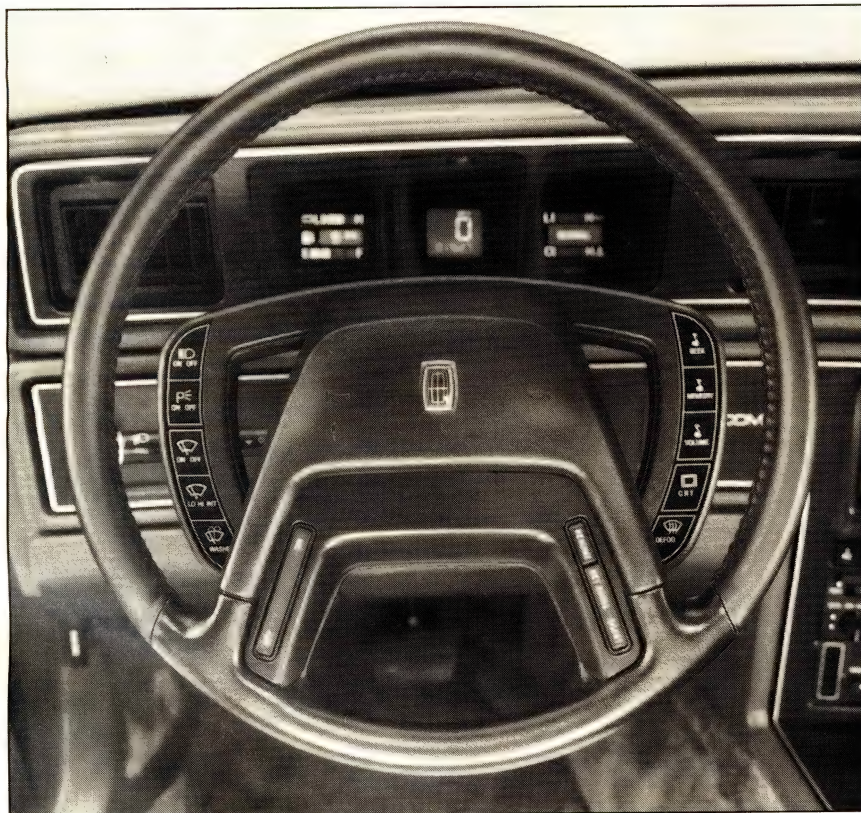
Stewart thinks the most important challenge now facing automotive electronics is the precise resolution of sensor data: exact measurements of fuel flow, engine rpm, continuously variable transmission ratio, and the like. "To achieve [increased] precision, the main requirement is not necessarily I/O but longer data words—which means the more widespread use of 16-bit processors," he says.

A cautionary note, however, is often sounded when the discussion turns to handling large amounts of data in an automobile. For no matter how the data is processed, signals can get crossed in an over-the-road environment where vibration, high temperatures, and electromagnetic interference are the norm (Fig. 2).

Though the present state of the art—even for multiplexed data transmission—is still twisted-pair wiring, greater data volumes will soon necessitate the use of coaxial cable, which may in turn be replaced with EMI-proof fiber-optics technology (see "Automakers see need for EMI protection," p. 49).

"Optical fiber will be cheap enough for the passenger car as soon as it's produced in quantity," Stewart predicts. "What's still missing are the connectors and the transceivers. But they'll become available once car makers start identifying the need for them."

A more immediate market than cars for electronic multiplexing may be the truck-



A more immediate market than cars for electronic multiplexing may be the truck-

2. Signal integrity. In order to reduce steering-column wiring costs while maintaining the signal integrity of instrumentation mounted on the steering wheel, Ford Motor Co. is experimenting with a multiplexing scheme in its Mark VII Comtech test cars. Building robust multiplexed signal paths for passenger cars is still years away, but their application in commercial vehicles may show up first.

AUTOMAKERS SEE NEED FOR EMI PROTECTION

As the electronic content of the typical U.S.-made automobile is expected to increase threefold between now and 1990, automotive engineers will face a continuing design challenge: that of protecting both the critical and noncritical electronic systems from being zapped by electromagnetic interference.

"We're putting more kinds of modules on the car, so there's a greater opportunity for one box to affect another box," says Dennis E. Florence, manager of power train, electrical and electronics for Chrysler Corp.'s Engineering Division.

Likewise, problems can arise from equipment added by customers. Improperly installed cellular radio telephones have been a recent cause of headaches, observes Wesley A. Rogers, president of Electronic Development Inc., a consulting firm in Grosse Pointe, Mich., that specializes in EMI protection. A cellular phone system that is not properly grounded can set up ground or current loops running through a car's chassis, Rogers notes. "There have been instances where cars have actually stopped."

More perils await the user in the form of the systems' exposure to a variety of potentially interfering outside radiating sources; these can range from radio and TV broadcast stations to mobile radio transmitters and fixed radar installations. "There's a tremendous amount of EMI out there on the road," Rogers says. Illegally souped-up high-power citizen's band radios sometimes used by truckers, for example, can interfere with vehicle-control systems in nearby cars, according to Rogers.

"The automakers don't talk about it," says Hugh Rozman, industry director for the surface transportation group at Amp Inc., a connector manufacturer in Harrisburg, Pa. "But even though they do test very thoroughly, they have problems with cars stopping. They're trying desperately to

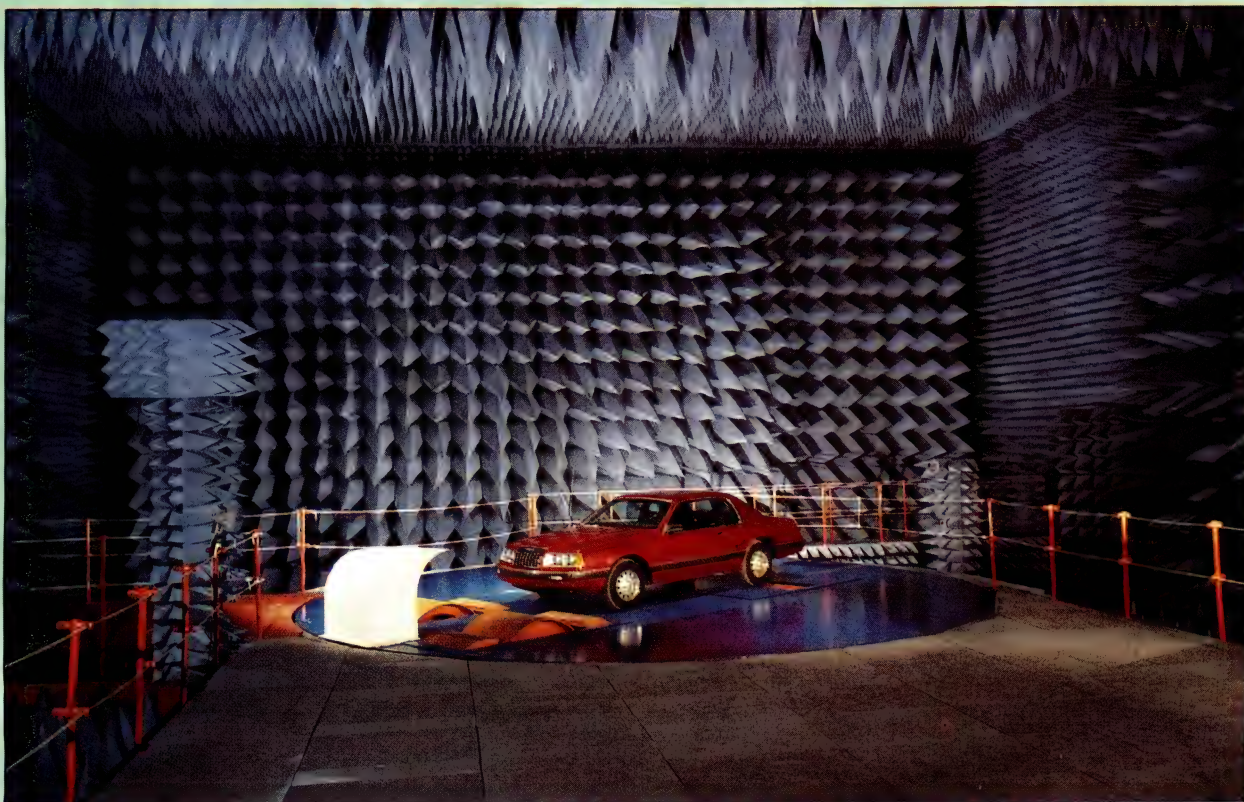
design these systems to prevent [this] from happening."

"The thing we really concern ourselves with is these 100-W-type mobile transmitters used by police and taxi systems," says Arnold D. Nielsen, a specialist in electromagnetic compatibility for Ford Motor Co.'s Electrical and Electronics Division. "Most of the calls I get [involving problems in the field] are due to on-board transmitters."

Though the automakers concede the potential for problems as more electronics are added to already tightly packed automotive compartments, they say that difficulties can be held to a minimum through careful design and testing. General Motors Corp. has for several years been testing its vehicle designs for interference immunity in anechoic test chambers, where cars are subjected to a variety of high-power electromagnetic energy sources. And Ford Motor Co. this year opened a similar \$13 million testing facility at its Romeo, Mich., proving grounds that consultant Rogers says is "one of the most elaborate for testing EMI in the world."

Design solutions to prevent interference include the use of filtered connectors and various types of shielding, as well as future deployment of fiber-optics systems, which are naturally EMI-immune. As is usual in the cost-sensitive automotive industry, the protection must be built in at minimum expense.

"If we carried this to an extreme on every component, we could add \$200 to our cost, which would be several hundred dollars to the customer," points out Chrysler's Florence. "We want to make sure we have no problems, but we're not going to penalize all of our cars to protect against some sort of strange occurrence we discover in the laboratory that the customer will never see in the field." By one estimate, EMI-suppression costs currently amount to about \$30 per car, a figure that is likely to increase.



ing industry. Trucks are more expensive, which lessens the incremental cost of the electronics. And they carry valuable freight, which shippers will spend money to protect. Perhaps most important of all is the complex functionality in a truck, such as refrigeration, pressure sensors, and multiple brakes—all of which require constant monitoring.

A multiplexing standard is generally seen as desirable, and a joint committee of the Society of Automotive Engineers and the American Trucking Association is expected sometime this summer to propose a standard truck data link that conforms to the Electronic Industries Association's RS-485 protocol. The intent of the SAE-ATA resolution is to avoid having a different protocol for each sensor that a truck might use. With the standard, up to 32 sensors or microprocessor-driven control devices can be hooked into a single serial link. Data is transmitted to the engine or display panel as the link becomes available (usually a matter of milliseconds); no "traffic cop" computer is thought to be necessary.

Data transmission and processing in an automobile or truck is not visible to the consumer unless the data can be displayed. Thus, in the public's mind, the most obvious site for automotive electronics is on the dashboard. Dashboard displays themselves, however, are not particularly demanding of microprocessor power. CMOS is considered an absolute requirement because of its low power requirements (permitting the storage of information like odometer count and radio-station presets when the car is not running) and its high temperature tolerance. But the advanced high-speed CMOS processors used to control engine functions are not considered essential to run the relatively sluggish changes reflected by a dashboard's graphics.

Jamie Kirk, Intel marketing manager for consumer operations, says, "Any 8-bit [CMOS] processor is adequate for whatever data a driver could use. More important from a marketing standpoint is how the display looks." Kirk predicts that automakers will soon offer a variety of dashboard displays as options that a consumer could select as he would factory-installed audio components; it is simply a matter of reprogramming the electrically erasable programmable ROMs to display other functions. Even analog displays could be used in this scheme, except that needles on the gauges would be video representations rather than mechanical devices.

Using what we've got

There is an enormous amount of unused computational power at hand for today's automobiles, according to Stewart. The Motorola 6801 and 6805, he points out, "are 8-bit machines that can do just about everything you'd want to do in a present-generation automobile. The trick is not to overwhelm the driver with data."

For example, a driver always needs to know the speed and fuel level, but he needs to know the status of a taillight only if it's not working. An ideal dashboard would display information on this type of system only after a failure has occurred.

Stewart also suggests speech synthesis as one possible mode for informing a driver of infrequent events, thus avoiding visual clutter entirely. Similarly, Stewart predicts that the speech-recognition devices now coming on line [*ElectronicsWeek*, April 22, 1985, p. 34] will enable drivers to control comfort and entertainment functions by uttering phrases like "set air conditioning: six-eight degrees; radio: bass down two." The overriding goal is to make it easy for the driver to keep his eyes on the road.

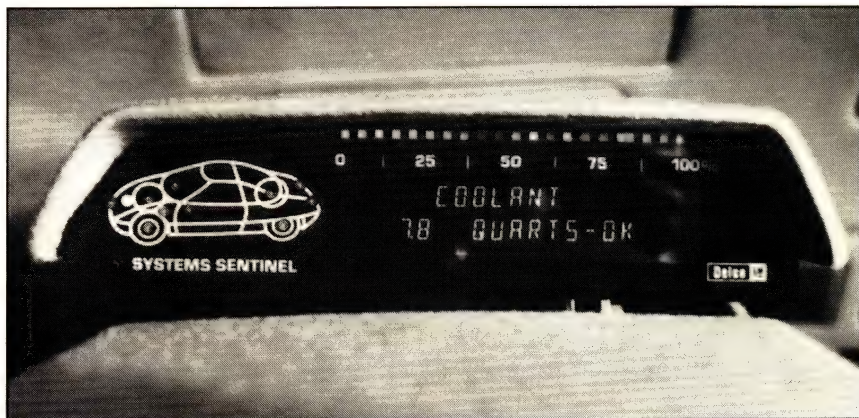
Head-up data displays on a car's windshield—similar to the kind projected onto the canopy of advanced fighter aircraft—

are an eventual possibility. Both Stewart and Phail are for the idea, at least in principle, and so far no automaker has rejected it out of hand. No one, however, has yet voiced any plans to build one (Fig. 3).

A driving display

For automakers, programming status and trip-computer functions onto a standard dashboard is not difficult; the big challenge is to move different display technologies from the benign circumstances of home and office to the much more rugged environment of the road. The first company to use electronic instrumentation was General Motors Corp., but the past several years have seen Japanese manufacturers move to the forefront through the use of multicolored liquid-crystal displays and vacuum fluorescent displays.

Other technologies have also been explored. Electroluminescent and plasma-gas displays, for example, which offer certain advantages over LCDs [*ElectronicsWeek*, April 22, 1985, p. 56], have generated considerable interest from the military



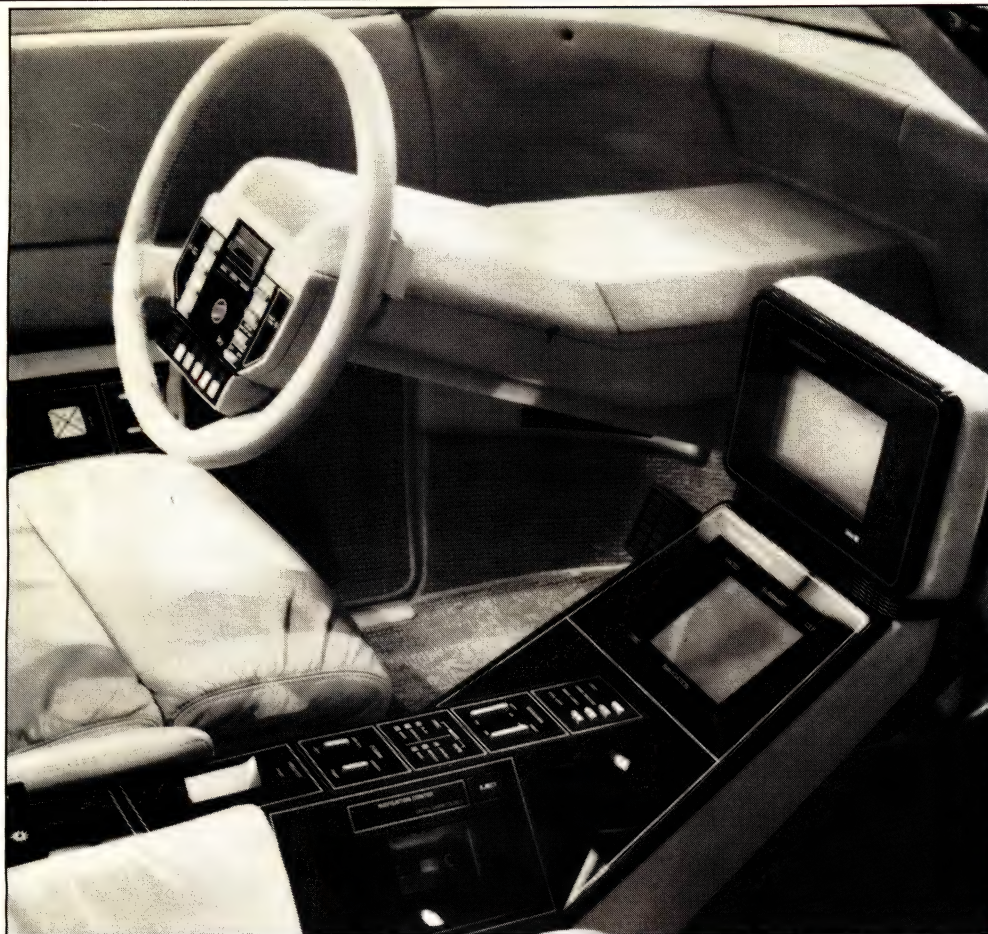
3. System sentinel. Head-up instrumentation displays like those used in aircraft may soon be popping up in cars' steering columns. The experimental system used in Buick's Questor displays a number of operating parameters, such as coolant level and battery voltage.

(Fig. 4). For consumers, however, factors such as data retention and ease of memory mapping do not loom large, simply because the amount of data that a driver can actually use is relatively small, and because the chief concern of most drivers is real-time information on the road. Therefore, when an automaker selects a display technology, simplicity of manufacture and low cost to the consumer become paramount.

Other considerations are brightness and ruggedness. LCDs are inherently rugged and have a low cost of manufacture, but their brightness and contrast ratios have often been deemed inadequate for automotive applications. Takeo Sakabe, president of Asahi Glass Co. in Yokohama, Japan, claims these problems have been overcome. LCDs using guest-host dyes now provide enough contrast to be competitive with any other display technology, even in direct sunlight. Sakabe reports that low-temperature switching speeds have also been improved, obviating the need for a heater in the display.

Motorola's Stewart believes that "LCDs will eventually win out over the competition," but for the present he sees a strong case for cathode-ray tubes, too. The advantages of CRT displays are their inherent brightness and easy addressability, with which screens full of information can be displayed in user-selected sequence. Indeed, some 1986 Buick Rivas will use a dashboard CRT to display trip, climate, and audio-system information, including a video service manual for mechanics [*ElectronicsWeek*, Nov. 12, 1984, p. 28].

Less dramatic, but ultimately more important than any information display is safety. Today, probably the most important safety advance on a production car is the antilock braking system developed by ITT Corp. The system works by



4. Future viewing. Because the amount of data a driver actually uses is relatively small, automakers typically favor LCDs because they are rugged and easy to manufacture. As auto information systems become more sophisticated, electroluminescent touch-screen displays like the one used in the Buick's Questor may find a ready market.

Stein, manager of semiconductor research and development at GM's Delco Electronics Division, Kokomo, Ind. "The difficulty is ruggedizing them to work in a car." Accordingly, piezoelectrics are especially promising because they can convert noise and vibration into information, rather than simply having to be protected from them.

Other sensing tasks involve obstacle detection, for which sonar is touted as the simplest tool. Toyota Motor Co. has been offering a back-sonar system for its home market that alerts a driver to obstacles within two meters of the car as it is backing into a parking space. No U.S. manufacturer has yet ex-

electronically sensing the sudden deceleration of a panic stop and automatically pumping the brakes to prevent skidding. German cars—Mercedes-Benz and BMW—have been offering this widely advertised option for a number of years; as its cost has fallen (to about \$1,000), high-end Fords and other vehicles are also beginning to use it.

Dubious future for electronic braking

But the prediction that all cars will soon have electronic braking may not come true, simply because the antiskid function can now be accomplished hydraulically at a cost far below that for electronic braking. A joint venture between Ford-Werke in Cologne, West Germany, and Lucas Girling Ltd. in the U.K. has produced a purely mechanical system designed primarily for front-wheel-drive cars.

Instead of using electronic sensors on the wheels, the Stop Control System, as it is called, uses a mechanical modulator—similar to a shaft encoder—that regulates the flow of braking fluid according to the wheels' angular momentum. A sudden deceleration mechanically pumps the brakes. The cost for SCS is about \$300, and it will be available as an option on every Ford by the beginning of 1986. Whether Ford will still offer the more expensive electronic braking—which is slightly more capable in terms of response time and precision braking on all wheels—remains an open question.

Though the elimination of the electronics from antilock braking may not be the happiest news for electronics suppliers, they may take solace in the fact that maintaining a vehicle's integrity is not completely separate from information handling. Carey Wilson, CRT project chief for GM's Buick Motor Division in Flint, Mich., points out that electronic display of previously unsensed parameters such as dirty oil, low air pressure in tires, or excess humidity under the hood can save a driver a lot of trouble.

"It's easy to find applications for sensors," says Frank S.

pressed definite plans for anything similar, but Stein expects that they all will in the near future.

One possible approach is already at hand: Polaroid Corp.'s Ultrasonic Sensor, an extremely accurate device for its low cost, which has found widespread use in robot positioning systems as well as in the focus control of Polaroid cameras. "Only the supervisory electronics present any kind of difficulty," says Stein. "You have to integrate obstacle detection with the car's transmission so it knows when it's in reverse, and you need a distinct audio warning to alert drivers without also annoying them."

Other sensors may use radar or microwaves to spot more distant obstacles, such as slow-moving cars or other road hazards. But a low-power collision-avoidance radar that was tried out in the UK—where fog is a chronic problem—never made it into production. The main reason was the high cost of manufacturing the radars and integrating them into an automobile's electrical system, but an additional problem had to do with the many false alarms the radar was giving: on a curve, for instance, it would sound the signal for an obstacle when the car was in a straight line with an object that was well off the road. In addition, there is the potential for signal clutter if radar and microwave devices begin to proliferate.

The trucking industry, however, may be more amenable to radar because the potential consequences of a truck collision can be expensive, not to mention catastrophic. And the potential for signal clutter is smaller because there are fewer trucks than cars. One firm, Preston Trucking Corp. in Preston, Md., has ordered more than 500 radars that were developed by Vehicle Radar Safety Systems of Detroit. The units continually send out a stream of microwave pulses whose echoes are then evaluated by an on-board microprocessor. If an obstacle is detected, an alarm is sounded and if necessary, the brakes are applied automatically.

Another kind of signal-reception device an automobile might



use is for navigation (Fig. 5). For the electronics industry, the most promising technologies involve the use of digitized maps stored on optical disks. But optical systems for cars are still expensive (Sony Corp.'s audio compact-disk player is about \$700, installed), and to be of use in navigation they have to accurately process a positioning signal. Thus, the day when automakers might commit themselves to electronic positioning for production vehicles is not in the immediate future, but they are considering a number of proposals for an electronic navigation system to replace the road map.

Navigation by FM

The least exotic of these systems entered production a few years ago, but market acceptance has been limited because they rely too heavily on external signals that are not always at hand. The Automatic Radio Information system from Blaupunkt GmbH, for example, simply decodes an FM signal to give drivers in the New York and Chicago areas updated traffic reports for their particular routes. Its navigational capabilities are limited to suggesting alternate routes in case of a tie-up. Other prototype systems in Europe and Japan make use of signal emitters along the road. A navigation unit equipped to receive the signals triangulates the vehicle's position and superimposes it onto a CRT map. The scheme's drawback lies in the expense of outfitting thousands of roads with the emitters.

Koji Takigawa of the Hanshin Expressway Public Corp. in Osaka, Japan, has proposed an intermediate scheme that would give more comprehensive traffic updates than ARI, but would not yet attempt to provide useful navigation information. Takigawa's proposal involves adding speech synthesis to a network of relatively cheap ultrasonic detectors that have already been installed at 500-m intervals on the 124-km-long expressway. "Today, the detectors relay information on traffic flow, weather, and accidents to a network of 244 changeable message signboards, but a greater volume of more detailed information can be transmitted by voice," says Takigawa.

To implement voice information—received by means of a carrier frequency on a vehicle's FM radio—a cable antenna with a high electric field is buried along the road. The high

formation but receives no outside signals, so it can't alert a driver to traffic or weather hazards. Magnetic strips in the non-drive wheels—calibrated at the time of installation—send a signal to a differential odometer that scrolls a digitized map on standard audio cassette tape. When a vehicle makes a turn, inertial sensors send a correction to Etak's computer, which has 256-K bytes of RAM. Don Warkentin, marketing director at Etak, explains that an area the size of greater Los Angeles would require four such cassettes at a cost of \$35 each. Optical disks would store much more information, but, he says, "[Optical disks] are not reliable or cost effective enough yet." (Etak system hardware is about \$1,500, installed, including monitor.)

Perhaps the most exotic technique for automotive navigation involves positioning satellites. Every automaker has extolled its potential benefits, but for now government regulations and high costs are combining to keep this technology firmly in the future [*ElectronicsWeek*, May 27, 1985, p. 23].

Truckers out in front

Trucks, however, could use it sooner. Within a year or two, civilian receivers for the Defense Department's Global Positioning Satellite network will be available and probably cost around \$2,000—although they won't be as accurate as the military GPS receivers. A fleet owner, with valuable cargo in his trucks, may well pay that premium to keep tabs on his rigs. Eventually, if the Mil-Spec GPS receivers (accurate to within 10 m of true geodetic position) are given the go-ahead for civilian use, digitized electronic maps that respond to GPS signals could even find their way into the family sedan, especially in rural areas.

Another device that might appeal to fleet owners (but would be anathema to truckers) is a black box modeled after aircraft flight recorders. Pall Theodorsson, an engineering professor at the Science Institute of the University of Iceland in Reykjavik, has suggested that for about \$20, a shaft encoder could be mounted at the speedometer that would record a vehicle's speed at 2-s intervals and store the information for an hour on a 2-K-byte chip. In case of an accident, or if the vehicle is stopped, police and insurance companies could get a readout of the driver's behavior. □

5. Wrong turn? Accurate navigation systems for production vehicles that would combine maps stored on optical disks with electronic positioning is still a dream yet to be realized. But a number of manufacturers are considering proposals for an electronic navigation system to replace the road map.

field level is considered necessary for noisy urban areas, but Takigawa maintains that the antenna will not interfere with broadcasts on other frequencies.

There is even an artificial-intelligence component to Takigawa's proposal: automatically prioritizing the severity of simultaneous incidents. The total number of program steps needed for the task is approximately 70,000.

Another system, this one from Etak Inc., Sunnyvale, Calif., uses an inertial scheme to give positioning in-

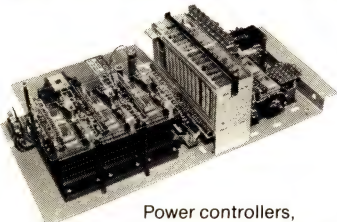
We'll put "zero-defect" components in your hands on "just-in-time" schedules.

Custom transformers, power supplies and power controllers are our business. We'll help you design them, then produce them for you in quantity.

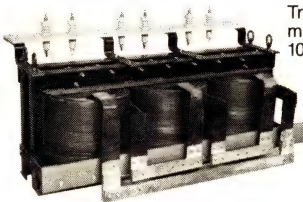
Zero defects means they're guaranteed first quality. "Just-in-time" delivery keeps your inventory costs down; matches stock to your production line needs.

Tell us your needs. Our experienced engineering staff will come back with the complete answer — including a prototype — using state-of-the-art technology. And they'll come back fast.

Save time and money. Let Basler help.



Power controllers, including custom motor speed controllers.



Transformers — single or multi-phase, to 1.5 MVA, 1000 Hz, 20 KV.



Find out more about Basler.
Send for our free *Design Ideas* portfolio today.

BMP-4109

DESIGN IDEAS
from Basler



Basler Electric

Dept. EW, Highland, IL 62249 USA
618-654-2341 TWX 910-996-2522

Circle 45 on reader service card

Electronics July 15 issue

For Space
Reservations Call:
Production Department
(212) 512-3140

ATE on the Factory Floor Plus NCC (July 15-18) Preview

Learn what's been proposed as low-cost alternatives for expensive and dedicated automatic testing equipment (ATE). Plus coverage of optical inspection systems for printed circuit board testing, purchasing versus leasing equipment, and robotics on the factory floor.

The Market

An estimated 27% of the U.S. test and measuring equipment market in 1982, with an increase to 47% expected by 1995.

Target Readers

Technically trained corporate managers and test engineers.

Issue Date: July 15, 1985
Closing for Advertising: June 24, 1985

Electronics
Influence Beyond Design

Cost Effective



Smaller engines need cost-effective mabuchi dc mini-motors

...because they reduce engine load & save weight & space. Perfect actuators for air conditioner ventilating flaps, door locks, remote control mirrors, window lifts, seat adjusters, defoggers, tire inflators, windshield washers, etc. Choose from over 50 models — Economy, Low Noise, Heavy Duty, High-Torque, Electronically Governed Series.

On-time delivery from 11 factories in 3 countries — 1.5 million per day! 100% final-tested.

Used in a wide variety of applications — consumer, audio, electronic, industrial — where economic rotary motion is required.

Call or write **Mabuchi Motor America Corp.**, 475 Park Ave. S. New York, NY 10016.
Dept. EW685.
(212) 686-3622.
Telex: 23-4374 Mabu.
Fax (GIII) 212-532-4263.



MABUCHI MOTOR

The biggest name in small DC motors.

Circle 53 on reader service card

COMMUNICATIONS

SLIC CHIP SHRINKS PHONE-LINE INTERFACES

**INTEGRATED CIRCUIT REPLACES POWER-HUNGRY HARDWARE,
ALLOWS FOR MORE SUBSCRIBER LINES ON EACH CARD**

A single-chip subscriber-line-interface circuit has become available that continues the revolution in telephone switching gear being caused by integrated circuits. The SLIC chip replaces much bulky, power-hungry hardware, such as transformers, feed resistors, off-hook supervision circuits, ring and test-relay drivers, and polarity-reversal relays, thereby reducing the size, power requirements, and cost of telephone switching products. The subscriber-line-interface function links an individual telephone line to the internal switching electronics of the switch gear.

Integrating the SLIC onto a chip has been a formidable challenge because the final product must combine the ability to handle low-level voice signals with the capability of operating in the traditional telephone world of 50-V batteries and 100-V ringers—not to mention the 1,500-V surges caused by lightning strikes or other electrical transients.

Advanced Micro Devices Inc. has now brought a single-chip SLIC to market. Because one SLIC is needed for every telephone line, the designers were careful to look for ways to implement their SLIC chip with the best possible price-to-performance ratio.

Ideally, according to Merle Miller, a product planning engineer at AMD, a SLIC should be inexpensive, small, and require very little power. One telephone exchange may contain thousands of SLICs, so even a small improvement in any of these areas can have an enormous effect on the quality of telephone switch products using it. AMD's single-chip SLIC, the Am7950 (Fig. 1), does a good job measuring up to these requirements, according to Miller.

The part is now coming into full production. The Am7950 grew out of a partnership between Rifa, a division of L.M. Ericsson Telephone Co., Stockholm, Sweden, and AMD. Rifa developed the SLIC, which AMD produces. The Am7950 SLIC is used in conjunction with the AMD-developed Am7901A subscriber-line audio-processing circuit (SLAC), which Rifa is also manufacturing.

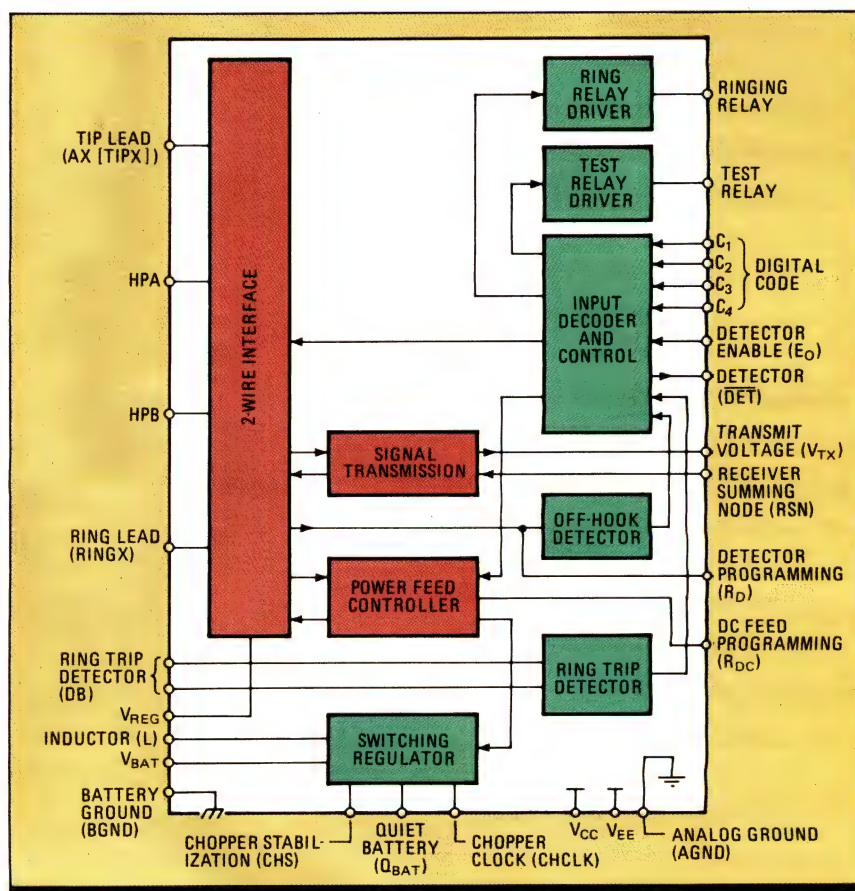
1. Hello. A block diagram of the Am7950 single-chip subscriber-line interface circuit (SLIC) shows the many functions required to interface a telephone line to switching gear.

The SLIC chip is being accepted at the early stages of its product life cycle, according to Joe Jarrett, an AMD marketing executive in Austin, Texas. "Sales are going well and we have design-ins with numerous CO [telephone central office] and PBX [private branch exchange] manufacturers in both the U.S. and international markets," he says.

Design challenges

Putting a SLIC on a chip presents several design challenges. Telephone sets require 30 to 40 mA of dc current, which often must be delivered over several miles of wire. This requires a dc feed from a 50-V supply. At the same time, this circuitry must transmit voice signals as low as 1.5 mV root mean square. This results in an effective dynamic range of the system of approximately 90 dB.

Additionally, because telephone-wire pairs run for long distances in cables packed with other wires, there is a great deal



of longitudinal coupling between lines. The SLIC must reject longitudinal-coupling signals. Also, the length of wire connected to the SLIC can allow dangerous foreign electrical signals, such as power surges from power-line crosses and lightning, to enter the chip.

A big advantage of the IC approach over transformer-based circuits is that many more line circuits can be placed on one line card. This factor is very important in telephone switching gear because the bulk of the switching apparatus is in the line cards, where SLICs reside. Older line cards commonly contain four lines, which means, for example, that a 10,000-line switch has 2,500 line cards. Increasing the number of lines per card to eight with the Am7950 would decrease the bulk of the switch by as much as 40%.

Even more important is the need to decrease power requirements. This becomes critical when a large number of low-resistance lines are off-hook at the same time. When this occurs, power dissipation in the line cards is at a maximum and can limit the number of lines permissible in a rack, calling for bigger power supplies and batteries. However, because of the lower power dissipation of the Am7950 in an off-hook mode compared to other SLIC implementations, high line-card density is possible. For example, a 2 x 200-, 50-V resistive feed could dissipate as high as 6 W in driving a short line whereas the Am7950 would dissipate less than one fifth of that.

Single-chip design

The developers of the Am7950 claim that it also has a number of advantages over other semiconductor SLICs. It is a single-chip design and it requires no high-precision external components. It has an on-chip switching regulator to reduce the voltage on low-resistance lines, thus eliminating the need for high-power-dissipation feed resistors. Finally, since it can either source or sink line current, it can perform polarity reversals easily; longitudinal currents can exceed loop current without clipping.

The Am7950 features both software and hardware programmability. Software programmability allows the controller to adapt the SLIC dynamically to a variety of conditions such as on-hook, off-hook, ground start, reversed polarity, unconnected instrument, ringing, and test. Hardware programmability allows the line card designer to use resistor and capacitor choices to alter key SLIC parameters, which include such areas as two-wire impedance, feed resistance, and loop-detect current.

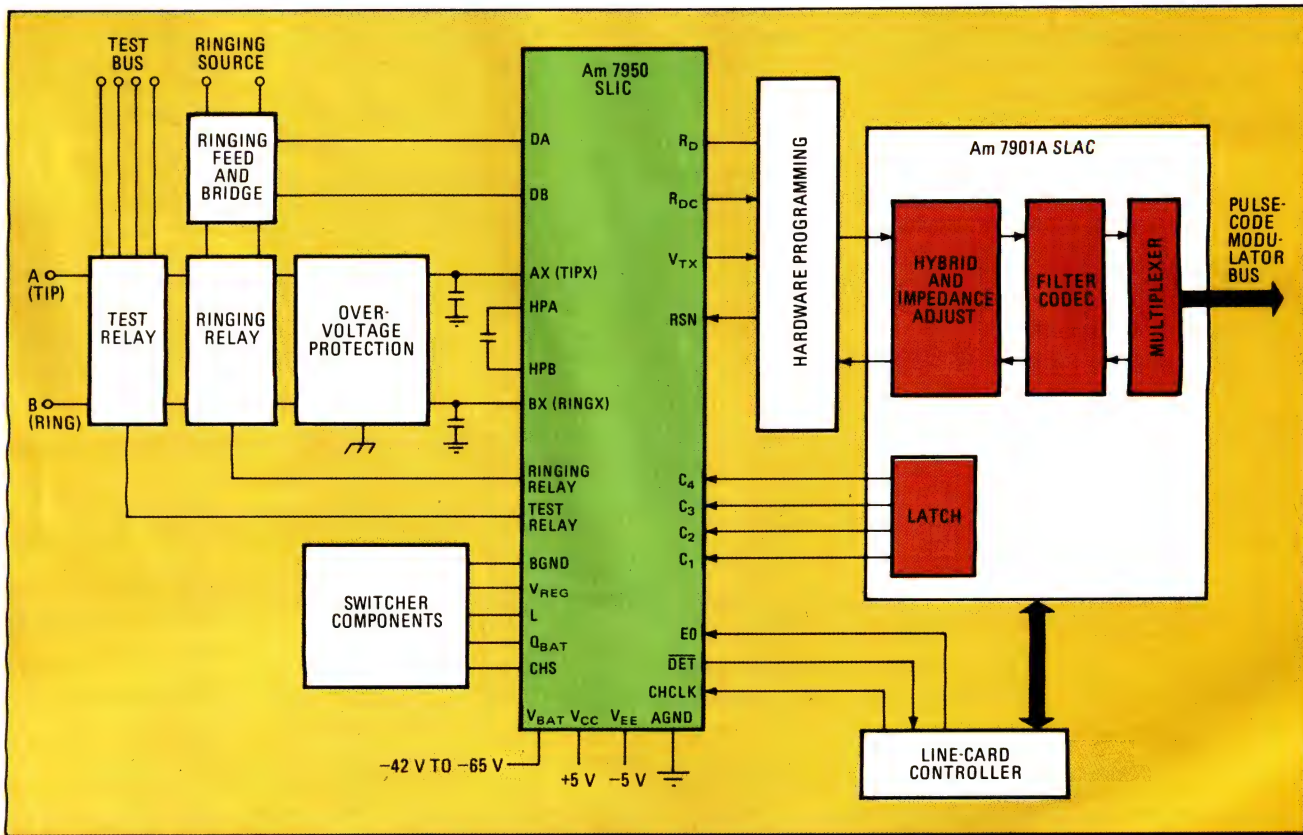
A complete, programmable subscriber-line circuit can be implemented using an Am7950 SLIC and an Am7901A SLAC (Fig. 2). Four TTL-compatible inputs to the SLIC (C_1 through C_4), which can be driven by the SLAC, provide software control of the operating mode of the SLIC. One input controls the test relay and operates independently of the other three inputs, so that testing can be done in any mode. The remaining inputs allow the SLAC to put the SLIC into one of seven operating modes.

The SLIC's main operating mode is the normal active mode, which is used to feed off-hook phones. When the phone goes on-hook, the controller can place the SLIC into a reduced-power, or disable mode.

The Am7950 provides an additional signaling mode called polarity reversal, wherein the dc functions of the tip and ring leads are interchanged. This is useful on trunk lines, for example, to indicate when a call has been answered. The line-card microprocessor can reverse the polarity of the SLIC in either the normal or disable modes with no other change in functionality.

If no phone is connected, the controller puts the SLIC into disconnect, its lowest power mode. The SLIC also has a ringing state in which the ringing relay output is activated and the ring trip detector is connected to the detector output pin.

Finally, the SLIC has a tip-open state for operating ground-start trunks. In this state, the tip lead is open and the ring lead is connected as a current source. The Am7950 notifies the



2. Programmable. A complete programmable subscriber-line circuit can be built with a single-chip SLIC, a SLAC chip, and a few other components. The SLAC controls software programming of the SLIC. Hardware programming options are added to the board as needed.

3. At the core. Two current-mode amplifiers driving the tip and ring interface form the core of the SLIC's two-wire interface. This is the most important part of the SLIC and is responsible for the actual interface to the ring and tip telephone lines.

line-card microprocessor if a subscriber requests service by grounding the ring line. The polarity-reversal and tip-open features are important on trunk lines to other exchanges and would usually require extra circuitry for implementation; however, on the Am7950 these features are included.

In addition to software programmability, the Am7950 has three key parameters that are programmed by external resistors and capacitors. They are the two-wire impedance, dc feed resistance, and the loop-detect (off-hook) current. This allows the switch manufacturer to adapt one basic line card to many environments.

The two-wire interface (Fig. 3) drives the telephone line by means of matched current-mode amplifiers. These in turn are controlled by separate metallic and longitudinal control currents. The longitudinal control current is generated entirely inside the chip and is used to set the longitudinal impedance and the longitudinal operating bias point.

On the other hand, the metallic control current originates outside the SLIC and enters through the RSN pin. This current has three components: the input from the received audio signal, ac feedback from the transmitter output (to set impedance), and the dc feedback from the R_{DC} pin (to set feed resistance).

The amplifiers are carefully designed so that I_{LI} causes very little metallic current and I_{MI} causes very little longitudinal current. This amplifier balancing is the single most important element in maintaining good longitudinal balance, and it saves the designer the trouble of providing tightly matched feed resistors.

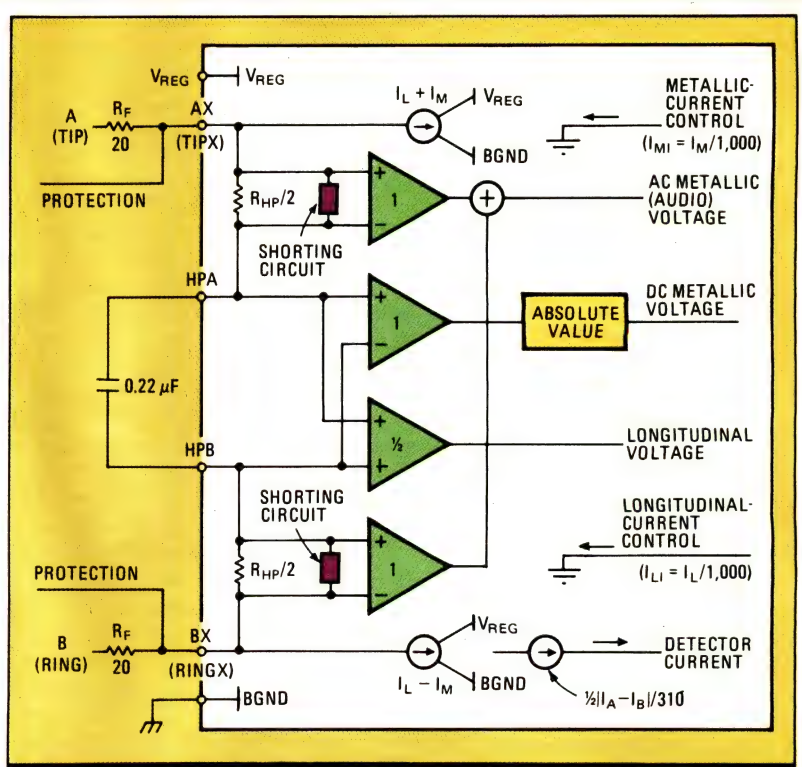
Paths are straightforward

The audio transmission paths (Fig. 4) in the SLIC are very straightforward. The transmitter section takes the ac-metallic voltage sensed by the two-wire interface and buffers it to produce the transmitter output on the V_{TX} pin. The receive path contains a current amplifier with the ac-metallic current being proportional to the current into the RSN.

Connection of an impedance (Z_T) from the transmitter output to the receiver summing node causes a current in the telephone loop of $1,000 V_{TX}/Z_T$. The SLIC therefore appears to the telephone line as an impedance of $Z_T/1,000$ (plus the impedance of the fuse resistors).

The accuracy of both the Z_T impedance and the SLIC amplifier gain affect the SLIC's two-wire impedance and, hence, the return loss. For this reason the SLIC's amplifier gain is tightly controlled. The SLIC provides no four-wire return loss; therefore, the receive voltage is echoed back to the transmitter output with a 180° phase shift and a small gain because the fuse resistors are outside the gain loop.

The battery feed in the SLIC has several modes. In the normal active mode, the SLIC appears to the telephone line as a resistance in series with a -50 -V supply. To simplify the circuit, the tip side of the line is held at -5 V and the resistance appears to be entirely in the ring side. Of course, the SLIC does not use an actual resistor, because too much power would be dissipated. Instead, the SLIC measures the voltage between tip and ring and adjusts the loop current to $I_L = (-50 \text{ V} - V_{AB})/R_{FEED}$. A built-in



switching regulator reduces the amplifier supply voltage to the minimum necessary in order to save power.

There are several other operating modes. The reverse active mode is exactly the same as the normal active mode except that the dc roles of the tip and ring leads are reversed. The reverse disable mode is exactly like the normal disable mode except that, as in the reverse active mode, the dc functions of the tip and ring leads are reversed.

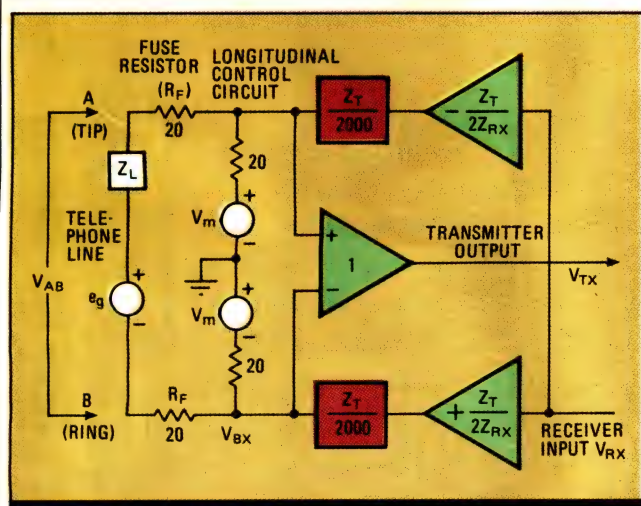
In the disconnect mode, the tip and ring leads appear to be an open circuit and everything except the control circuits is powered down. In the ringing mode, the tip and ring leads appear to be an open circuit, and only the ringing relay driver and the ring-trip-detector circuit are operational. The final mode is the tip-open state, where the tip pin is an open circuit and the ring produces a constant current.

The longitudinal circuit measures the sum of the HPA and HPB leads, compares it to the desired longitudinal voltage, and sends a current proportional to the error voltage to both telephone lines. The net effect is that the telephone inputs appear to have a longitudinal impedance of 20Ω per wire. The low longitudinal impedance allows the amplifiers to remain in their linear region in the presence of significant longitudinal noise.

Off-hook detection

The SLIC detects off-hook in all operating states except disconnect. In the normal active, reverse active, disable, and reverse disable states, the Am7950 SLIC produces a current from the R_D pin that is proportional to the loop current and compares the voltage on the R_D pin to a reference to produce the off-hook indicator. The value of the resistor from R_D to V_{EE} sets the threshold off-hook current.

In the tip-open state, no current flows from the tip, so that the effective loop current is half of the ring current; otherwise, the off-hook detection is the same as for the other states. In the ringing state, off-hook is detected differently, because the ringing feed is an external circuit. A resistor bridge from the ringing feed is connected to a high voltage comparator on the SLIC and the output of



4. Can we talk? The audio-signal-transmission section of the SLIC handles the two audio paths. The transmitter output is derived by buffering the ac metallic voltage, while the receive path contains a current amplifier, with the ac metallic current being proportional to the current into the receiver summing node.

the comparator is the off-hook indication.

The relay drivers consist of transistor switches to V_{CC} capable of sourcing 25 mA. In addition, each driver has a protection diode to V_{BAT} . Each driver can hold off voltages down to V_{BAT} .

The SLIC also has many features that allow the construction of very flexible line cards. Every line has polarity reversal without the addition of a relay and the ability to operate ground start trunks without extra circuitry. Therefore, the same line card can be used for internal telephones as well as trunks. In addition, two-wire impedance, feed resistance, and loop-detect level can all be altered by changing resistors and capacitors. Although not as convenient as software-controllable parameters, these programmable components still allow a basic line card to be reconfigured easily for use with different line types and in different countries.

Because the SLIC is built in a 70-V technology, it needs some external parts to deal with overvoltage, ringing, and test. Overvoltage conditions are handled by placing 20- Ω fuse resistors in series with tip and ring, and employing thyristor circuits to sink the current to ground when the voltage becomes too large. The fuse resistors dissipate lightning surges and short power line crosses but open up in case of a sustained power line cross. The ringing circuit consists of an on-chip relay driver to energize the ringing circuit, the ringing feed resistors, and a resistor bridge for ring trip. The SLIC also provides an on-chip relay driver, which can be used to energize a test relay to connect the line and channel to a test bus.

Handling the call

The Am7950's flexibility is illustrated by following what the line-card microprocessor does as it uses the Am7950 to handle telephone calls. Initially, if the subscriber line (or trunk) is unused, the microprocessor leaves the SLIC in the disconnect mode to conserve power. When a line is placed into service, the microprocessor uses the test output of the SLIC to test the line and channel.

Next the microprocessor places the SLIC into the mode appropriate to the type of line, usually the disable mode for a loop start line or tip open mode for a ground start trunk. On conventional line circuits, this option is not available, because dedicated lines handle the ground start trunks. If the Am7901A is being used with the SLIC, the microprocessor

uses it to program the transmission parameters of the channel. At this point, the line is ready for telephone calls.

How the microprocessor deals with a telephone call depends on who initiates the call. With subscriber-initiated calls, the SLIC's detector output indicates to the microprocessor when the line has gone off-hook, and the microprocessor places the SLIC into the active mode. The microprocessor continues to monitor the SLIC's detector output for either rotary dial pulsing or an on-hook. Rotary dial pulses appear as strings of alternating on- and off-hooks that the microprocessor interprets. Once dialing is complete, the microprocessor simply watches the detector output for an on-hook.

On trunks to other exchanges, reversing the line polarity will indicate when the call is answered and billing starts. Without the Am7950, this function requires an extra relay in the line circuit and a special type of board for lines with polarity reversal signaling.

When the call is initiated from another line, the microprocessor places the SLIC into a state reflecting the type of line: ringing for an ordinary loop start line, active for a ground start line, or reverse disable for a loop start line with polarity reversal. In all three cases, the microprocessor watches the detector output until it indicates an off-hook. Then it places the SLIC into the active mode for ground start or ordinary loop start lines or into the reverse active state for a line with polarity reversal. The microprocessor completes the call by returning the SLIC to its original mode.

One telephone channel application

The Am7901A provides the coding hybrid and control-interface functions for the Am7950. In addition, it provides software control of gain, two-wire impedance, and transhybrid balance.

The external networks, Z_T and Z_{RX} , allow the manufacturer to set two-wire impedance matching the telephone lines to be connected. Probably the best strategy is to set the SLIC for 600 or 900 Ω resistive and to use the SLIC to modify the impedance to the correct level. This reduces the parts count and lets one board connect to lines with differing impedances.

The feed-programming resistors, R_{DC1} and R_{DC2} , allow the user to set the correct feed resistance for the lines that will be connected. Finally, the loop-detect-programming resistor, R_D , allows the user to choose the correct off-hook threshold. All of these programming changes can be made without altering the basic circuit board.

To initiate ringing, the SLIC provides a driver to pull in a ringing feed circuit using a relay. It also provides a comparator to detect the output of the bridge resistors, R_{B1} , R_{B2} , R_3 , and R_4 , which detect loop resistance. Balanced or unbalanced ringing requires only minor modifications. The switcher components are of fixed value.

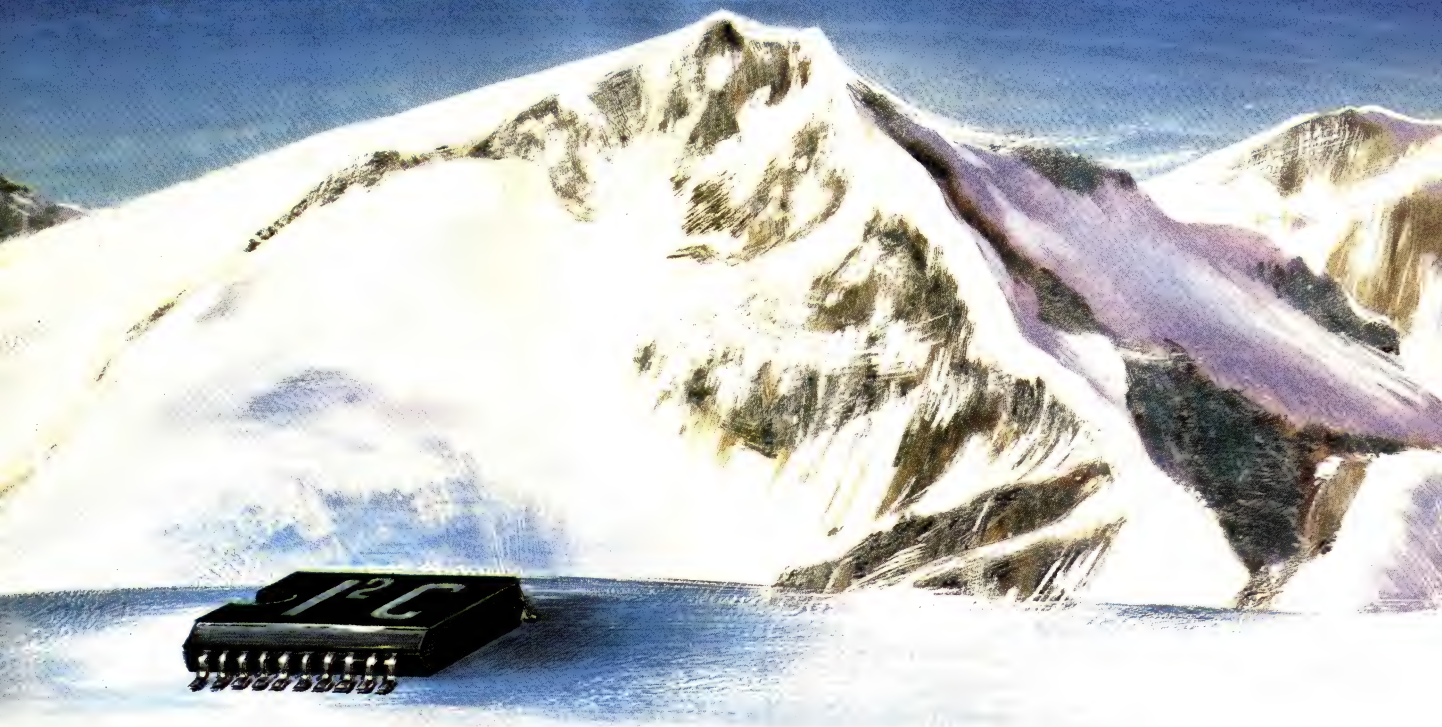
Switch design is concerned with choosing the type and layout of the components. The testing function depends very much on the choices of the switch designer; therefore, the Am7950 provides a relay driver, and the designer connects the outgoing telephone line and the SLIC output to his own testing buses.

The final design choices involve the protection circuit, and this will depend on the applicable surge specifications. The fuse resistors that limit the surge current are special components, because they must survive short surges but open rapidly in case of power crosses, and they must be well matched.

Firms that make appropriate devices for this purpose are TRW Inc., Plessey Co., and Rifa. The other needed components are diodes to ground that can handle 60-A surges and zener/thyristor circuits to short out negative surges exceeding -60 V. One possibility is the LS5060 from SGS Ates. □

Cool Chips

**Low-power CMOS chips
clip to the I²C-bus
to speed your systems to market**



The Philips I²C-bus family of CMOS and bipolar circuits. With on-chip interface to clip to the two-wire, serial I²C-bus and give you speed, flexibility and economy in system design. A fast-growing family of processors and general-purpose as well as dedicated peripherals.

A family with solid benefits!

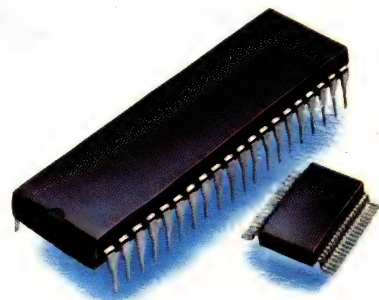
Modular! You go straight from concept to products.

Flexible! Your basic designs are adaptable and expandable. And your software is standard

modules. Benefits at every stage, plus the gains of using standard ICs.

And with Philips ICs in CMOS you gain still more. Interference protection, low power, high noise immunity and a very wide supply voltage range. Ideal for portable and battery-backed systems, particularly in our so-small SO-packages.

For more information, contact:
Philips Electronic Components
and Materials Division,
5600 MD Eindhoven,
The Netherlands



Philips put I²C-bus chips in standard DIL as well as in SO and VSO mini-packages. Comparison shown here is between 40-pin DIL and 40-pin VSO.

Making the Most of CMOS

PHILIPS



Electronic
components
and materials

Circle 59 on reader service card

DIGITAL SCOPES OUTPACE ANALOGS IN USES AND GROWTH

A roundup of recent offerings sees new and traditional players packing in more punch

The list of jobs that can be done only by digital storage oscilloscopes is growing so fast that the market for the instruments is increasing 25% a year. By comparison, analog scopes are going up just 10%. The total market for all scopes last year was estimated to be close to \$1 billion, 10% to 15% of which was in digital scopes.

The tasks they are being asked to perform are becoming increasingly sophisticated and sensitive. An example: testing the welds in pipes in nuclear reactors. Such an application for Gould Inc.'s model 4500 is described by Jim D. Jones, product manager in the Design and Test Systems Division. Under the control of a computer, an automatic pipe-weld tester echoscans a pipe. The scope, with a rate of 100 megasamples/s and a 35-MHz bandwidth, picks up the very high-frequency soundwaves and passes the digitized results to a computer for analysis. Air bubbles or any crystalline patterns in the welds can be determined by the shape of the transients detected.

Then there is the high-resolution Nicolet scope, with its long record length and freedom from low-frequency noise or drift, that sits deep inside Frustration Mountain in New Mexico. It records the measurements of a tiltmeter so sensitive that it detects the tidal tilt of the Earth's crust in nanoradians.

There are other examples in the fields of electrochemistry, soundwave recognition, ultrasonics, neurology, and robotics. However, to continue to capture sophisticated applications, tomorrow's scopes will have to have greater bandwidth, deeper memories, and analog-to-digital conversion sections with ever-increasing resolution.

In addition, companies are experimenting with different

types of storage features, says Edward White, a vice president and investment analyst with the E.F. Hutton Group Inc., New York, who also provided the market estimates. He uses as an example Tektronix Inc.'s liquid-crystal shutter, which designers can use to provide a color display using a black and white tube.

In the view of Russ Nord, director of new-product development at Norland Corp., pre- and post-triggering is "where digital scopes really have the edge; analog scopes can't even compete." Both analog and digital scopes can perform post-triggering. However, pretriggering is possible only with digital scopes: it is possible to capture the pretrigger portion of the signal because the data is constantly being converted and stored in memory prior to the trigger event.

Digital scopes will be integrated into more compact packages, White forecasts, adding that in 5 to 10 years integrated packages will contain a number of analog measurement instruments along with a digital scope. The scope would be a vital element, especially because it can work with a data base.

Additionally, White predicts that eventually there will be a single desktop terminal that allows engineers to conceive, debug, and test a design, integrate the product's hardware and software, and test and debug a prototype of it. "Hewlett-Packard and Tektronix will be particularly strong in integrating the digital storage oscilloscope into the computer-aided-engineering system," he says.

In the meantime, engineers can choose from a host of digital scopes that pack a powerful punch. Most offer some kind of optional waveform processor, which allows the user to mix waveforms, add or subtract one from another, expand or



Single shot. Hewlett-Packard Co.'s model 54200A (above) is so fast at 200 megasamples/s that it can easily detect and capture transients as short as 10 ns in duration. The scope's analog bandwidth is 50 MHz.

Transfer. With a built-in RS-232-C serial port, the model 1425 from Gould Inc. (right) can transfer data to and from a computer. Additionally, the interface lets users read and remotely control most front-panel settings.



compress them, or use them as known-good measurements from which to test other waveforms. Additionally, scopes usually offer RS-423, RS-232-C, or IEEE-488 interfaces to allow data or commands to be read to and from an external computer for external storage, calculations, or remote control. Many can be equipped with optional disk drives, and one from Nicolet even lists bubble memory as a storage option.

The latest scope from Gould's Recording Systems Division, the 1425, is a low-end 20-MHz dual-trace unit that can function as a conventional real-time instrument as well as a digital storage instrument for both transient capture and high-speed storage of repetitive signals. The \$2,950 unit's sampling technique lets it capture and process repetitive signals up to 20 MHz in the storage mode—a digital scope not using this technique would require a sampling rate of 200 MHz per channel to provide the same resolution.

From Nicolet comes the NIC-320, which boasts a bandwidth in excess of 25 MHz and input-voltage ranges of ± 150 mV to ± 60 V full scale. Each input incorporates a 10-MHz 8-bit digitizer for fast transient measurements combined with a sampling mode of up to 200 MHz for studying repetitive signals. Up to 100% full-screen pretrigger information and 10-s post-trigger delay can be selected with a cursor. The memory on each of its two channels is 4,000 words. Priced at \$7,900, the scope can be delivered in 90 to 120 days.

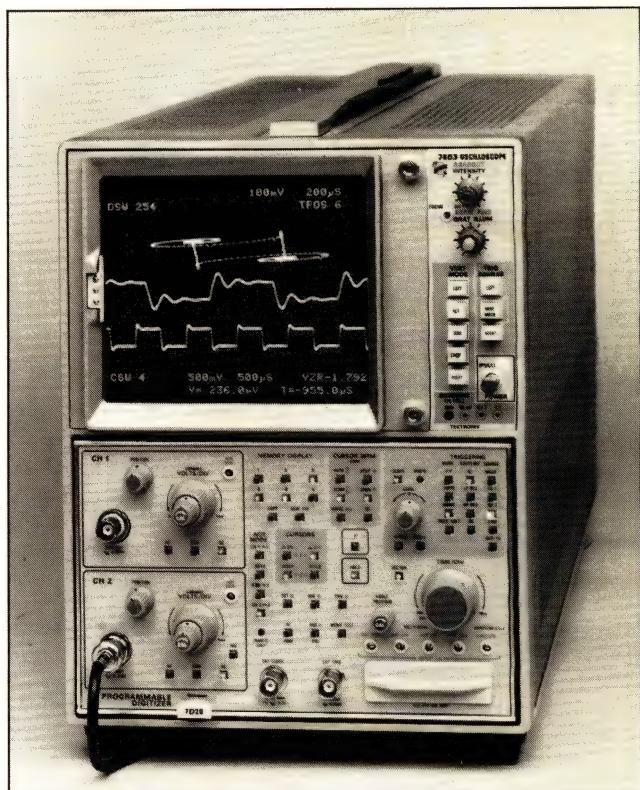
Fast and flashy. Transients as narrow as 10 ns can be captured with Hewlett-Packard's HP 54200A/D. With its 50-MHz bandwidth and a variety of automatic measurement capabilities, it is also useful as a general-purpose scope. It samples at a 200-MHz rate and uses a 6-bit flash analog-to-digital converter on each of its two channels. The 54200A is priced at \$7,600 and the D model, which adds sophisticated triggering modes, is \$9,800.

The market's growth rate has recently attracted a few newcomers. LeCroy Research Systems Corp.'s entry into the market is an instrument with deep memory, some 32-K words on each of two channels.

Known for its expertise in instruments for the nuclear industry, LeCroy in its model boasts an interleaved sampling rate of 5 GHz and a bandwidth of 125 MHz. A precise time-measurement technique makes it possible to measure repetitive signals at full bandwidth with measured points every 200 ps. Both input channels feature 100-MHz, 8-bit analog-to-digital converters. Priced at \$14,900, the scope is available now.

Panasonic, which entered the instrument marketplace only a couple of years ago, is now introducing a digital scope that can record repetitive signals up to 10 MHz and single-shot events at up to 500 kHz. The \$4,800 VP-5730P can display four waveforms and alphanumeric information on the screen simultaneously. The scope has a nonstorage mode in which it offers a 50-MHz, dual-trace, and delayed-sweep features.

Another newcomer to the market is Leader Instrument Corp. with its LBO-5825, a 35-MHz, two-channel unit with a 2-



Dynamic duo. Teamed up and priced under \$10,000, Tektronix's 7603 mainframe oscilloscope and its 7D20 digitizer provide a 10-MHz single-shot bandwidth and a 70-MHz bandwidth for repetitive signals.

K-word memory and a 5-MHz maximum sampling rate. Priced at \$3,850, it is available two weeks after ordering.

In portables, Kikusui International took the wraps off a dual-channel 20-MHz scope that costs just \$1,500. It stores up to 400 kHz in the sine-interpolation mode and has a fast 1.6- μ s rise time in the pulse-interpolation mode. Iwatsu Instruments' SS-5802 has three channels but only a 10-MHz bandwidth. The \$2,700 scope's memory capacity is 4,058 8-bit words.

Both Tektronix and Norland have digitizing modules to add to their instruments. Tektronix recently lowered the price on its 7D20, which provides a 10-MHz single-shot bandwidth and a 70-MHz sampling rate for repetitive signals. Teamed with the 100-MHz plug-in mainframe 7602 scope, the package is now priced at \$9,695. For those applications not requiring a display, the 7D20T package, including the 7D20 plus a power supply, sells for \$8,690.

Norland's model N4007 digitizer, for use with its prowler scopes, provides 12-bit resolution. The 1-MHz digitizer sells for \$1,000.

—Steve Zollo

LEADING DIGITAL-OSCILLOSCOPE MANUFACTURERS

Gould Inc., Recording Systems Division, 3631 Perkins Ave., Cleveland, Ohio 44114.

Phone (216) 361-3315 [Circle reader service number 400]

Nicolet Instrument Corp., Oscilloscope Division, 5225 Verona Rd., Madison, Wis. 53711 [Circle 401]

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 402]

LeCroy Research Systems Corp., 700 S. Main St., Spring Valley, N.Y. 10977. Phone (914) 425-2000 [Circle 403]

Panasonic Co., 1 Panasonic Way, Secaucus, N.J. 07094.

Phone (201) 392-4050 [Circle 404]

Leader Instruments Corp., 380 Oser Ave., Hauppauge, N.Y. 11788. Phone (516) 231-6900 [Circle 405]

Kikusui International Corp., 17819 S. Figueroa St., Gardena, Calif. 90248.

Phone (213) 515-6432 [Circle 406]

Iwatsu Instruments Inc., 430 Commerce Blvd., Carlsbad, N.J. 07072. Phone (201) 935-5220 [Circle 407]

Norland Corp., Rt. 4, Norland Dr., Atkinson, Wis. 53538.

Phone (414) 563-8456 [Circle 408]

Tektronix Inc., P.O. Box 1700, Beaverton, Ore. 97077.

Phone (800) 547-1512; in Oregon (800) 452-1877 [Circle 409]

GRAPHICS BOARDS MEET CAD DEMANDS FOR SPEED, RESOLUTION

Number Nine's Revolution line boasts the fastest pixel rate available for the IBM PC

Poor resolution and tortoise-paced processing have long plagued personal computer-based computer-aided-design and -engineering systems. Although the trend toward small CAD environments is growing all the time, computer makers have failed to achieve the high processing speed and graphics resolution that CAD demands from small machines.

Number Nine Computer Corp., Cambridge, Mass., is betting that the latest additions to its Revolution series of single-board graphics controllers for IBM Corp. Personal Computers not only meet the graphics half of the challenge, but surpasses it. The four new boards are among the first to use Hitachi Ltd.'s HD 63484 Advanced CRT Controller chip.

Each of the boards possesses an addressable window of 2,048 by 1,024 pixels and boasts the fastest pixel rate of any graphics board available for IBM's PC line—100 MHz. According to Will Frentz, vice president for marketing at Number Nine, the boards' resolution is the key to their quality, but their speed will command the market's attention.

That 100-MHz speed makes possible noninterlaced operation at high resolution, he says, which eliminates the distracting flicker in systems that rely on interlaced operation. But Number Nine alone could not have bestowed such speed on the Revolution series; it achieved the high pixel rate thanks to the Hitachi controller.

The on-board controller-chip graphics coprocessor works with the PC's own microprocessor to help eliminate operational bottlenecks by offloading many of the graphics tasks from the CPU. The chip supports figure drawing, raster operations with fully programmable raster parameters, absolute and rel-

ative addressing of both the X and Y coordinates, 16× zoom, random polygon fill, roam, bit-block transfer, vector drawing (at a rate of about 0.5 μ s per pixel), and clipping.

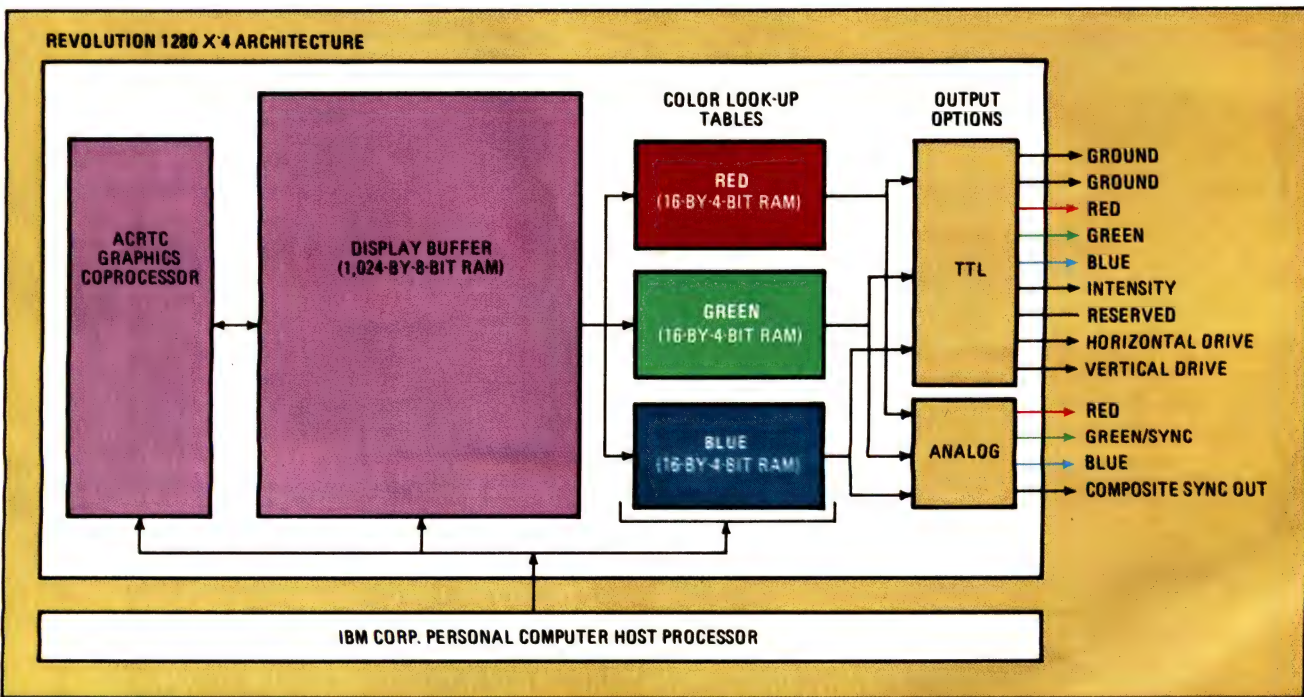
With the roam function, the user can pan and scroll his way throughout the full addressable window; clipping prevents wraparound within the viewable window, cutting a vector when it reaches the viewable window's boundaries rather than letting it wrap and come back through on the opposite side.

The controller chip also has programmable split-screen and window features. Coupled with its fast clock rate, the 13½-by-14¼-in. single-slot board's ability to perform these functions simultaneously makes a single-monitor work station possible, so the user can make multiple DOS windows as he runs an application program. "The combination of these features on one compact board provides a graphics control environment previously unavailable on PC-based systems," says Frentz.

The board's memory-mapped, multiported architecture permits uninterrupted access by both the controller chip and the computer's microprocessor to the board's display buffer. The architecture allows the user to update the 1-megabyte CHMOS display memory while refreshing the bit-mapped display screen. Software control lets the system designer choose which processor—the host CPU or the controller chip—is faster in a given task.

"It allows him to use the optimal method for a specific job," Frentz says. "There's total flexibility. There's nothing encumbering your ability to write to the board."

Because the choice between CPU and coprocessor is selectable from software, a user can run off-the-shelf software on a Revolution system without alteration, he says. The multiport-



Multiple windows. Thanks in part to Hitachi's Advanced CRT Controller chip and its multiported architecture, Number Nine Computer Corp.'s Revolution board has the speed and processing power to permit designers to place DOS in one window while running an application in another.

ed design "also allows the CPU to do fast dumps into memory," Frentz adds.

The multiported architecture presents other advantages too, he says, pointing out that uninterrupted bus access makes possible data rates approaching 1 μ s per byte on the PC and PC/XT, and 0.6 μ s on the PC AT. The only limit to the potential speed of the boards is the power of the host CPU, he explains.

The four boards offer selectable bit planes in the form of three software-access modes: plane, pixel, and controller-chip drawing. Each mode permits a different addressable format. For example, in plane mode the host processor can directly access the display buffer one bit-plane at a time. One byte in a read/write cycle updates eight (16, when configured for the PC AT) pixels in one plane. Optimizing speed in low-color-content updates, the focus of the buffer in this mode is on the fastest possible update in a single bit-plane.

In higher color-content image applications, pixel mode al-

lows the CPU to access the buffer in a pixel-by-pixel sequence, focusing on reading and writing whole pixel values (all four planes deep). In the controller-chip drawing mode, the graphics coprocessor can offload the CPU and perform hardware figure drawing and raster operations. The result is that the CPU can process applications as the controller chip performs specialized vector drawing or clipping functions.

The Revolution boards support four operating shells: VDI, from Graphics Software Systems, Nova*GKS from Nova Graphics Co., Halo from Media Cybernetics Inc., and Metawindows from Metagraphics Inc. Set for release in late July, the boards are priced as follows: \$3,995 for the top-of-the-line board with a 1,280-by-1,024-pixel viewable window; \$2,995 for the model with a 1,024-by-768-pixel viewable window; and \$1,995 for the boards with 832-by-624-pixel and 640-by-480-pixel viewable windows.

—Tobias Naegele
Number Nine Computer Corp., 691 Concord Ave., Cambridge, Mass. 02138. Phone (617) 492-0999 [Circle 338]

FASTER SIMULATION SYSTEM IS STILL ACCURATE

A series of turnkey systems for circuit simulation takes advantage of advanced algorithms, parallel microprocessors, and special accelerator boards to simulate circuits 20 to 100 times faster than a Digital Equipment Corp. VAX-11/780 running Spice2. The increase in performance doesn't sacrifice simulation accuracy; in many cases the software offers increased accuracy and will produce meaningful results where Spice2 did not, says Jeffrey Deutsch, chief technical officer for the startup firm, Shiva Multisystems Corp., that developed the systems.

Circuit simulation is a highly computation-intensive task. IC designers would typically perform far more simulation than they do, if the computer time fit their budgets. "Circuit simulation consumes up to 60% of all CPU time used in the design cycle, and as such constitutes one of the biggest, most expensive bottlenecks in the industry," explains Dharam Ahuja,

president of Shiva Multisystems. However, simulation "is still the only way to functionally verify the performance of a finished integrated circuit before it's fabricated."

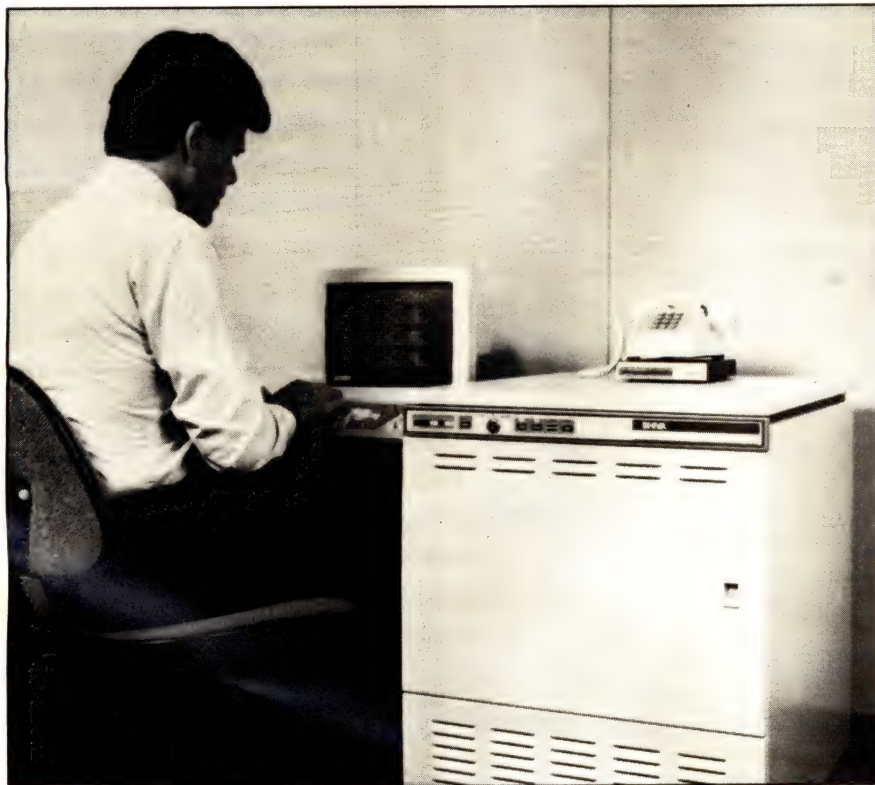
The SX-250 system, priced at \$125,000, outruns the VAX-11/780 twentyfold, and the SX-2000 system, which sells for \$350,000, is 100 times faster than the same system. Substantially higher levels of performance are expected in the near future, the company says.

This level of price-performance makes it practical for the first time for designers to optimize large circuits over temperature and process variations, says Deutsch. A single simulation of a large circuit, which may take hundreds of hours on a VAX, can now be done in a reasonable amount of time.

The Powerspice software can be transported to most environments where a good C compiler exists, including workstations and host computers. Deutsch developed its algorithms with Richard Newton at the University of California at Berkeley. The software divides a circuit into subcircuits, and with multilevel relaxation algorithms, the computer can concentrate on simulating the portions of the circuit that are changing more rapidly than others. If Spice2 and Powerspice are compared in speed while running on identical VAX hardware, Powerspice runs three to five times faster than Spice2, depending on the circuit simulated, says Deutsch.

The program was written to take advantage of parallel computer architectures, where it gains a further performance advantage. The SX series is based on parallel engines from Sequent Computer Systems Inc., which have 2 to 12 National Semiconductor Corp. 16032 processors working side by side. Powerspice was designed to work in any parallel architecture, using either messaging or shared-memory mechanisms for communication among processes.

Internally, Powerspice is a mixed-mode simulator that looks at the circuit at the gate or register-transfer-level, in addition to the circuit level. But all I/O is described at the circuit level, because Shiva wanted the user interface, includ-



POWER SUPPLIES

ing input parameters and output formats, to correspond exactly to that of Spice2, so designers don't have to learn new ways to work with the software.

The accelerator board Shiva has added to the Sequent machines was designed to execute Powerspice algorithms. It carries a 64-bit arithmetic logic unit and a 64-bit floating-point processor from Weitek Corp., and a great deal of cache memory. The horizontally microcoded design executes all instructions in a single cycle, and can calculate e^x in 1 μ s. IC houses can use a special compiler to embody their Spice models in microcode for the system.

The SX machines, which run under Unix 4.2, can serve as simulation servers on a local-area network, communicating with hosts or work stations over Ethernet. They currently can communicate with VAX computers running under Unix or VMS, IBM Corp. mainframes (or plug-compatibles) running under the VM operating system, and Unix-based work stations such as those from Sun Microsystems, Apollo, and Masscomp.

Shiva's customer-support program includes on-site and remote diagnostics, as well as extensive applications assistance, the company says. Production shipments of the SX-250, the SX-2000, and the SX-1000 will begin in July. The 1000 model offers half the performance of the SX-2000 at \$240,000. The firm seeks original-equipment manufacturers to resell the Powerspice on their hardware.

Shiva Multisystems Corp., 1040 Marsh Rd., Menlo Park, Calif. 94025.

Phone (415) 321-2350

[Circle 390]

200-W switching power supply runs 38,000 h before failure

Logic-level inhibit and TTL/CMOS-compatible power-fail signals are two features of the SDM200 series of multiple-output switching power supplies, which deliver an average of 200 W, with an additional 50 W held in reserve for heavy starting or intermittent loads.

Several versions are available in the SDM200 series: the A version handles high peak currents, while the B version is recommended for best all-around power regulation. The C version has an isolated, regulated +12-V output for monitor power.

The user can select input ranges of 90 to 132 V and 180 to 264 V ac. Outputs are +5 V, +12 V, +12 V isolated, -12 V, and -5 V. In the A and B versions of the unit, the isolated +12-V output may be paralleled with ± 12 V for higher current, or put in series with any output for higher voltage; this flexibility pro-

For quality and safety protection...



Specify thermal cutoffs, sensors and controls from Therm-O-Disc.

You can depend on Therm-O-Disc to help with a broad range of reliable sensors and controls in regular production. Everything from general purpose fixed-setting controls to pressure-actuated and temperature/current sensing switches. And our MICROTEMP® thermal cutoffs — available in many ratings and configurations — offer positive upper limit protection. T-O-D has been meeting the special needs of sophisticated customers since 1945. Call or write about your particular requirements. No obligation. We'll be glad to help.

Therm-O-Disc®

THERM-O-DISC, INCORPORATED



A SUBSIDIARY OF EMERSON ELECTRIC CO.

P.O. Box 3538 • Mansfield, Ohio 44907-0538

T-O-D Controls 419/756-5911 • Micro Devices Products 419/756-5005

Sales Offices World-Wide



vides the designer with a variety of field configurations.

Recognized by Underwriters Laboratories and the Canadian Standards Association, the SDM200 series also meets a range of standards that includes MIL-STD-810D (shock and vibration). The supply's capacitors are rated at 105°C, and the mean time before failure is 38,000 h, calculated according to MIL-STD-217D. In original-equipment-manufacturer quantities, the price of a single unit in the SDM200 series is \$104.22. Delivery is from stock.

Condor DC Power Supplies, 201 Flynn Rd., Camarillo, Calif. 93010.

Phone (800) 235-5929; in California, (805) 484-2851 [Circle 344]

Miniature power supply blocks rf interference in CRTs

Coping with limited space and the need for shielding from radio-frequency interference, the model 350 miniature power supply is aimed at CRT terminals and monitors. The unit's measurements are 2½ by 2 by 1¼ in., and it weighs 8 oz. The efficient dc-to-dc converter is well filtered and shielded. Furthermore, the power supply operates at temperatures from -20°C to +60°C.

Input voltage is +15 V dc, and ripple is 0.2%. Three output voltages are available: +12,000 V, +500 V, and -80 V; at these rated outputs, mean time between failures is over 100,000 h.

Fully encapsulated, the model 350 miniature CRT power supply comes with flying leads and a J1-21 high-voltage connector. Delivery takes up to four weeks; in quantities of 1,000 to 2,500, the component's price is \$50.15.

Emco High Voltage Co., 556 Weddell Ave., Sunnyvale, Calif. 94086. Phone (408) 734-9123 [Circle 343]



Thick-film dc-to-dc converters pack 5-W output

Measuring just 1.0 by 2.0 by 0.4 in., these miniature dc-to-dc converters put out 5 W. Manufactured in thick-film hybrid technology, the 7CCR series is available in four input ranges—5, 12, 24, and 48 V dc—and provide isolated outputs of 5, 12, 15, ±12, and ±15 V dc. An input pi filter reduces reflected input ripple to 15 mV peak to peak or less, and all models feature fully regulated outputs, low output noise, and foldback short-circuit protection.

Any model of dc-to-dc converter in the 7CCR series can operate at full load between -25°C to +70°C. An optional TTL-compatible enable/disable feature is available on request for large-volume applications.

Sample units are available now, and production quantities will be delivered in 8 to 10 weeks. In quantities of 1 to 24 units, the price is \$59.

International Power Sources Inc., 81 Speen St., Natick, Mass. 01760. Phone (617) 851-1818 [Circle 345]

Low-power 512-K CMOS ROM features 200-ns access time

Silicon-gate CMOS technology gets credit for giving the 23C512 512-K ROM an operating current of 40 mA, and just 40 µA when it is on standby. The 64-K-by-8-bit ROM has an access time of 200 ns.

The manufacturer claims the part provides several benefits in microprocessor systems, such as improved noise immunity, smaller, lower-cost power supplies, simpler packaging, and wider voltage tolerances.

The fully TTL-compatible ROM uses a 5-V power supply and is packaged in an industry-standard 28-pin DIP (Joint Electron Device Engineering Council pinout); a surface-mountable plastic leadless chip carrier will be available in the future. The 23C512 is priced at \$14.50 per unit in 10,000-piece quantities. Samples are available now.

NCR Corp., Microelectronics Division, 8181 Byers Rd., Miamisburg, Ohio 45342. Phone (513) 866-7217 [Circle 340]

256-K-word dynamic RAM comes in 18-pin DIP

For circuits that require minimal board space or wide word size, this 256-K-word dynamic RAM offers 4-bit-wide organization. Multiplexed row-and-column address inputs permit use of the smallest possible packages—the 18-pin plastic DIP and the 18-pad ceramic leadless chip carrier. Applications for the chip include high-resolution CRT displays and graphics terminals, where a wider word size is desirable and a total memory capacity of less than 256-K bytes is acceptable.

The circuit is available with access times of 100, 120, and 150 ns; these versions are designated MB81464-10, -12, and -15, respectively. In the plastic package, these are priced according to access speed at \$17, \$20, and \$26, respectively, for quantities up to 1,000. Housed in the ceramic leadless chip carrier, prices are \$21, \$24, and \$30, respectively, also in quantities up to 1,000. Samples and production quantities are available now.

Fujitsu Microelectronics Inc., Marketing Communications, 3320 Scott Blvd., Santa Clara, Calif. 95054.

Phone (408) 727-1700

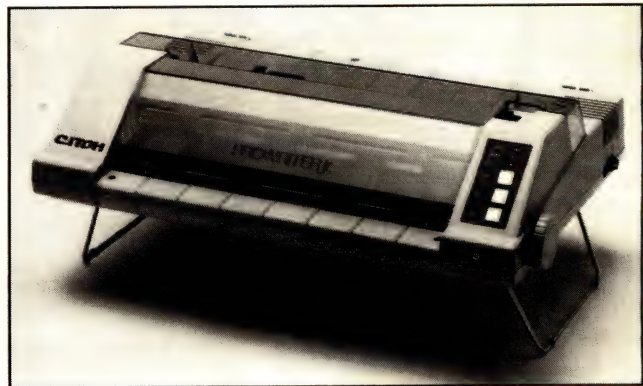
[Circle 341]

Paper-saving dot-matrix printer carries attractive price tag

A dot-matrix printer for the IBM Corp. Personal Computer, the Prowriter Jr. has a horizontal print head, so that paper can be loaded from the front of the machine. The printer also has a paper-saving feature, which prints documents on the first sheet fed into the paper train. The unit sells for under \$300. A second version with a serial interface for use with Apple microcomputers will be available later this year.

The Prowriter Jr. prints at 105 characters/s in near-letter quality, in which the print head makes two passes over each line. Throughput is 44 lines/min, and the design of the printer's front-feed rear-exit stand reduces the likelihood of paper jams, the manufacturer says.

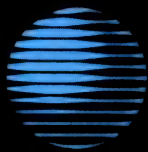
Software-programmable in nine language fonts, the Prowriter Jr. is useful in offices that handle international correspondence. Its footprint—15.2 in. wide by 11.3 in. deep—



Remote Control.



When you're on the road, don't leave your office to manage itself. Give them a call on AT&T Long Distance from a public phone. And make sure everything's under control. Wherever you are.



AT&T

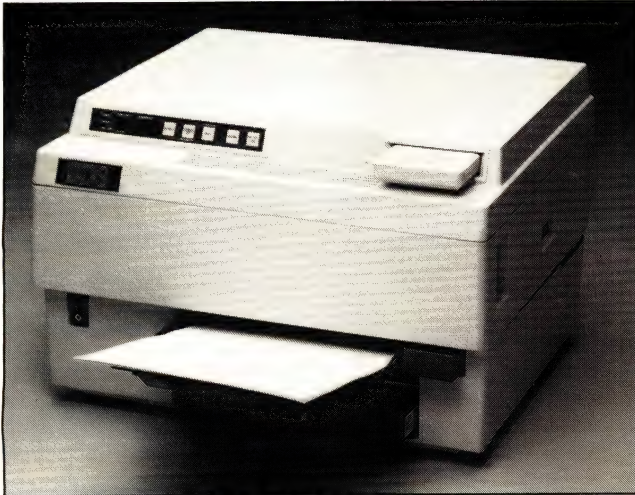
The right choice.

makes it suitable as a desktop printer. Both friction and tractor feed are standard, as is a Centronics-compatible parallel interface. Units are available now.

C. Itoh Digital Products Inc., 19750 S. Vermont Ave., Suite 220, Torrance, Calif. 90502. Phone (800) 423-0300 [Circle 351]

Laser printer accepts fonts downloaded from computers

Able to accept output from two computer systems through one parallel interface that is compatible with the IBM Corp. Personal Computer and one serial RS-232-C interface, the BDS Laser 630/8 can accept downloaded fonts from the host computers. This feature, the manufacturer points out, creates



opportunities for third-party font vendors to supply fonts, logos, and bar codes and to deliver those products on media that are compatible with whatever model of host computer is in use.

Nine type fonts are provided in the basic configuration of the BDS Laser 630/8; additional font cartridges are optional, including one that allows the host computer to download user-defined fonts. The laser printer, which emulates the Diablo 630 protocol, may have as many as 16 type fonts on line simultaneously.

The suggested retail price for the basic unit is \$3,495, and delivery is in two weeks after receipt of order.

BDS Corp., 800 Maude Ave., Mountain View, Calif. 94043.

Phone (415) 964-2115 [Circle 350]

Printer's daisy wheel has extended character set

Throughput of up to 80 fully formed, letter-quality characters/s and an enhanced 200-character extended-character-set (ECS) print wheel are the highlights of the Diablo Advantage D80 daisy-wheel printer. The ECS print wheel brings advantages to offices that produce specialized documents: it can handle multilingual, scientific and engineering, legal, Teletex, and financial and currency texts. Furthermore, the Advantage D80 can construct simple bar and line charts with mosaic print-wheel characters.

The Advantage D80 features an All Purpose Interface (API), developed for the model 630ECS that makes the printer plug-compatible with RS-232-C, Centronics, or IEEE-488 host-system interfaces. When it is connected to a print server, the Advantage D80 can support up to 16 work stations; the 256-character buffer, expandable to 1.5-K or 64-K bytes, allows printing to take place while the user moves on to other tasks.

A wide range of baud rates, buffer sizes, protocols, and

paper-handling configurations—including dedicated A-4 paper trays to accommodate European paper sizes—makes the printer a flexible instrument. DIP switches, knobs, and rotary switches have been eliminated in favor of a push-button control panel with an eight-character display (16 characters optional); the audible noise level is 58 dBA.

Volume-production quantities of the Advantage D80 will be shipped in the second quarter of 1985, at a recommended end-user price of \$2,195 per unit.

Diablo Systems Inc., P.O. Box 5030, Fremont, Calif. 94537.

Phone (415) 498-7000 [Circle 352]

Package lets IBM PC develop software for Multibus, others

Six hardware environments—including Multibus (using the 8085 and 8086 microprocessors), VMEbus (using the 68000), STD Bus (using the Z80 and 8088), and Multibus II (using the 80286)—are targeted by the Bus-Bridge family, consisting of 14 development packages that run on the IBM Corp. Personal Computer. Software under test is run on the actual target hardware, which simplifies the debugging of I/O-intensive industrial applications.

Besides the six target hardware environments, Bus-Bridge gives the designer a choice of three software systems: the target processor's assembly language, some of the IBM PC's popular compilers, or a fully featured assembler and compiler for maximum system utilization. The 14 Bus-Bridge packages offer combinations of the foregoing, and the manufacturer estimates that the system developer can save over 50% on capital-equipment expenditures by specifying one of the Bus-Bridge packages.

Each Bus-Bridge package includes a target-system CPU board, target-system RAM, a ROM monitor to operate the target system, an assembler for the target processor, an IBM PC disk with target communication and file-conversion utilities, and an RS-232-C cable for connection to an IBM PC. The designer then adds a target-system card rack with power supply, plus the IBM PC. Other packages add language compilers to the basic hardware and software components.

The price of packages, depending on which system is targeted, run from \$1,295 to \$5,595. Orders are shipped in two weeks.

Micro/sys Inc., 1011 Grand Central Ave., Glendale, Calif. 91201.

Phone (818) 244-4600 [Circle 356]



SOFTWARE

Video-processing software bows for DEC computers

User-developed programs for industrial measurement and control, machine vision, robotics, medical imaging—any computerized application that uses real-time video signals—are addressed by Vios (Video Input/Output Software). Vios works with Datacube's QVG family of video I/O and processing hardware, which plugs into any Digital Equipment Corp. VAX-11, Microvax, LSI-11, or PDP-11 computer system.

Vios subroutine calls perform such real-time video operations as image acquisition and display, spatial and temporal filtering, edge enhancement, and more. The high-level language supports applications programs written in Fortran, Pascal, as well as other languages; DEC macro assembly-language programs will also function with the Vios software package.

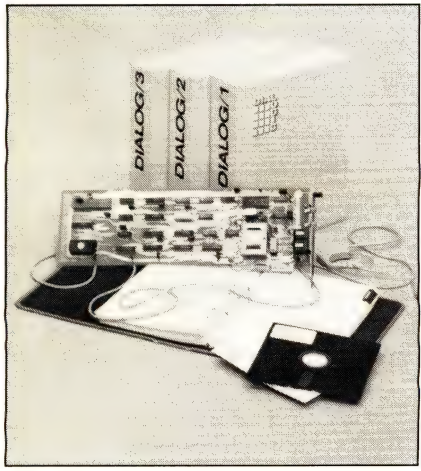
Vios is available now, and the price of the RSX-11 version is \$1,500; the manufacturer will quote the prices of other versions.

Process Software Corp., P.O. Box 746, Amherst, Mass. 01004.
Phone (413) 549-6994 [Circle 357]

Five routines help develop voice systems on IBM PCs

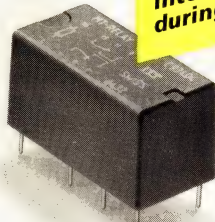
A voice data-base manager called VBase is the first of five modules inside Voice Toolbox, a set of software routines that gives development support to the manufacturer's Dialog voice I/O boards on the IBM Corp. Personal Computer. Other modules are Callstat, a call-progress package; Dime, a modem package; SPTools, a set of signal-processing routines; and DOSTools, routines that create an applications package using voice I/O.

The Dialog boards offer output to a speaker, a telephone-line interface, or full voice and data handling, depending

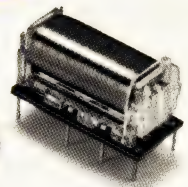
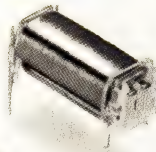


3

Modular design
Increased reliability by effective intermediate operational checks during production process.



MT
For a reliable future.

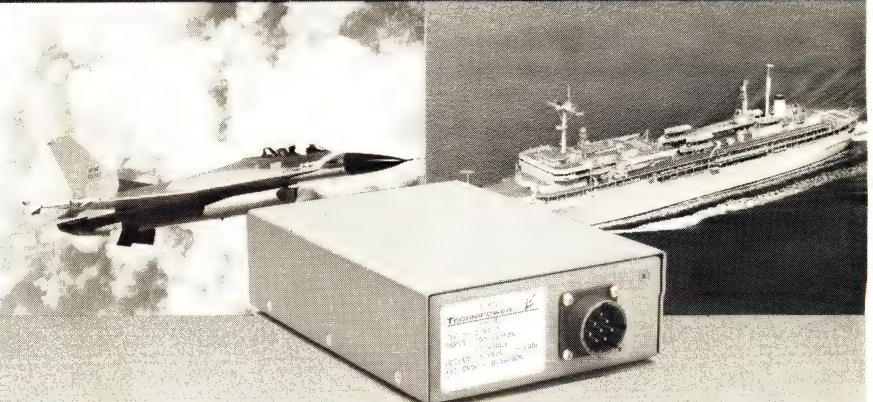


For further information and address of your local sales representative please contact:
Standard Telephon and Radio AG
Components Division
8027 Zurich/Switzerland
Tel. 01 201 42 55, Telex 815 385

ITT

Circle 67 on reader service card

Technipower "Mil-Qual" Triple Output Switching Power Supplies



Sealed or Field Repairable

The efficiency and size of a switcher, the output of a linear — all in a compact package! Available in AC/DC and DC/DC models, these "Mil-Qual" units are designed for severe shock and harsh environments. They feature a Mil-type input/output connector along with specially developed EMI/RFI filter circuitry. MTBF is 100,000 plus hours. Efficiency is 80%. Full power is provided at max operating temp., to 95°C, no derating.

Choose from 20 models which meet Mil-704, Mil-901 and other standards, have transient protection plus power ranges from 20 to 300W. 5 year warranty. Send for details.

We Do The Job Right!

TECHNIPOWER 

A pennell COMPANY

P.O. Box 222, Commerce Park, Danbury, Conn. 06810
Phones: (203) 748-7001; In Calif. (805) 493-2244

on the model chosen. Voice Toolbox can be purchased as a package for \$150, or each module can be purchased for \$50. The software is available now.

Dialogic Corp., 60 Baldwin Rd., Parsippany, N.J. 07054.

Phone (201) 334-8450

[Circle 359]

Software utility burns compiled C into EPROMs

High-level, compiled C language for the Z80, 8080, or 8085 microprocessors can be burned into EPROM using C-ROM, a software utility. Once the executable code is resident in the chip, programs can be written in C language, rather than in the primitive assembly language of the microprocessor, for quicker development of software routines.

In the modified C language used to create the C-ROM package, the standard library of function calls is still available, plus a special function library that has drivers, routines that initialize I/O devices, and—most importantly for industrial process control or communications—interrupt routines. Interrupts may call a software restart from C, or initiate functions, and the interrupt handler may be used in a CP/M environment. The special function library also lets the operator directly access 8085 rim/sim instructions directly from a C language program.

Including source code, the price of the C-ROM package is \$100, and delivery is immediate.

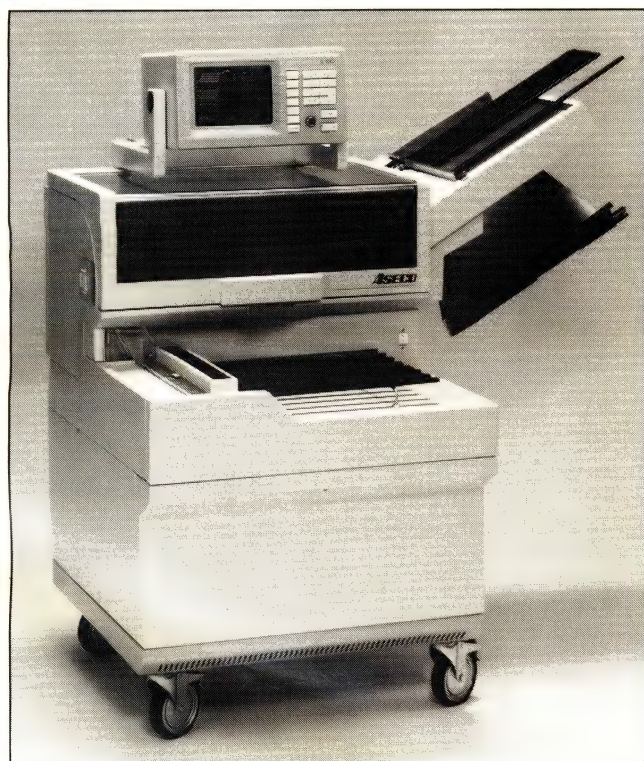
Computer Dynamics Inc., 105 S. Main St., Greer, S.C. 29651.

Phone (803) 877-7471

[Circle 358]

High-throughput test system handles surface-mount devices

The S-1560 Test Handler, a computer-monitored machine that can move devices even in temperatures from -55°C to $+150^{\circ}\text{C}$, can accommodate surface-mount devices. The test handling system is designed for high-volume production, and if test time is 500 ms, up to 3,600 devices per hour can be run through its cycle. The system's dedicated computer controls



all mechanical operations from loading to binning.

Optical sensors at each transfer point confirm device flow and report errors on a display terminal. Menu-driven proprietary software includes soft keys for quick setup, diagnostics, and maintenance. Prices are in the \$80,000 range. Delivery takes 12 to 14 weeks.

Aseco Corp., 110 Pleasant St., Marlboro, Mass. 01752.

Phone (617) 481-8896

[Circle 364]

72-channel test station handles four devices at a time

The newest member of Teradyne's J900 series of VLSI test systems, the J983 supports four 72-channel test stations and operates at a 40-MHz data rate and a 60-MHz clock rate.

The system allows up to four different devices to be tested concurrently. That versatility translates to high throughput, the company says. Thanks to Teradyne's patented 1-Mb pin-pattern generator, complex devices can be tested without the system having to stop and reload from the test-system computer or from external data sources, a further boon to the production speed. Pattern memory is 1 Mb per pin.

Configurable with up to 1,024 timing sets and format sets, the J983 allows devices of differing speed and complexity to be tested to specification in a single pass. Devices with special function or I/O pins can be tested because of the system's period generator and up to 18 timing generators, which are programmable in increments of 100 ps.

The dual-computer architecture uses the Unix operating system with Berkeley 4.2 enhancements; the computers, one for the high-speed, real-time testing environment, and the other serving as a user interface, communicate over an Ethernet. The system costs \$250,000 and delivery takes 36 weeks. Teradyne Inc., 21255 Califa St., Woodland Hills, Calif. 91367. Phone (818) 888-4850

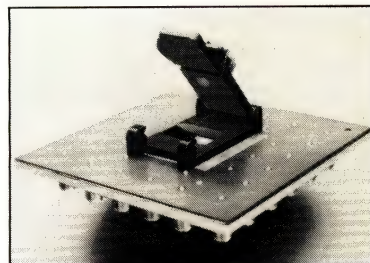
[Circle 365]

1-GHz fixture tests GaAs and ECL ICs

Operating at up to 10 GHz, a custom test fixture accommodates gallium arsenide and ECL ICs. With controlled or matched impedance signal lines, the fixture is offered complete with the company's proprietary multilayer board, a thermal mounting plate, high-frequency connectors, and a positive locking device. The tester eliminates the need to solder down devices during testing. Pricing was unavailable.

Augat Microtec, 2520 Turquoise Circle, Newbury Park, Calif. 91320. Phone (805) 498-9643

[Circle 366]



Bipolar array's I/O pins can be configured for ECL or TTL

Featuring I/O pins that can be configured for mixed ECL and TTL operation, the AmMPA1850, an 1,800-gate bipolar array, has worst-case gate delays of 1.2 ns.

Video-graphics and disk-storage systems can take advantage of the chip's high-speed and mixed logic I/O operation, the company says. The device's output macrocells can be configured to select its external logic levels: TTL, true ECL, pseudo ECL, or a combination. Multiple devices can be used in TTL systems, the company says, but they maintain ECL speeds on paths between arrays.

Enter the new era of MICROSYSTEM DESIGN

MICROPROCESSOR SYSTEMS: Software and Hardware Architecture delivers a wealth of information about microcomputers, peripherals, networks, signal processing and software, that leads the field in the 80's!

This book is a comprehensive collection of technical articles, carefully detailed and presented, in exclusive reprints from *Electronics Magazine*.

Corporate Managers, Project Managers, Design Engineers, Market Managers: **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** is one book for all!

Six knowledgeable chapters examine:

- Significant trends in the development of new software systems and applications
- Technical articles on the manufacture of new microprocessors
- Approaches to memory management used by major chip manufacturers
- Conveniences of peripheral chips
- Alternative network methods from Ethernet to token-passing protocols
- Modular procedures for making digital signal processing systems

Engineers - Save precious time by eliminating a cumbersome series of software instructions.

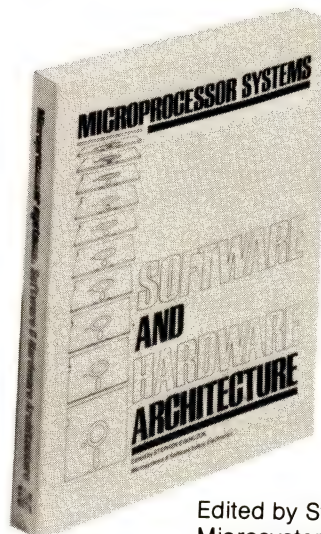
Directed chiefly at design tactics, **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** helps you avoid errors and overcome all your architectural problems.

- Brings you the needed simplicity of design, without sacrificing performance of the finished system
- Offers a means of tapping microsystems into the power of mainframe machines
- Recounts major breakthrough in dedicated chips that handle math operations in record time

Here it is -

MICROPROCESSOR SYSTEMS: Software and Hardware Architecture - Let it design for you!

Don't be left in the dark: **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** illuminates the design process of an ever changing industry.



Edited by Stephen Evanczuk,
Microsystems & Software
Editor, *ELECTRONICS*

In one resourceful volume, **MICROPROCESSOR SYSTEMS: Software and Hardware Architecture** lets you understand:

- Functions of hour end microprocessors and controllers
- Key microprocessors that trigger the personal computer revolution
- The importance of dedicated chips more sophisticated than mainframes of yesteryear
- Significant aspects of microcomputer software
- Efficiency of peripheral-control chips

**Don't delay -- order your
copy today!**

Use the coupon or send
in your company purchase
order.

MC GRAW-HILL PUBLICATIONS CO.

Attn: ECC
McGraw-Hill House
Maidenhead, Berkshire SL6 2QL
England
(Tel. (0628) 23431; Telex 848640)

Send me _____ copy(ies) of
**MICROPROCESSOR SYSTEMS: Software and
Hardware Architecture** for \$21.95 each. (U.S.
residents please include local sales tax).

- ☐ Payment enclosed (postage & handling included)
- ☐ Bill me (postage, handling & tax will be added) NOTE: All orders under \$30 will be sent a pro forma invoice requiring prepayment.
- ☐ Bill my company. Purchase order is attached.

Ship to:

Name _____

Company _____

Street Address _____

City _____ State _____ Zip _____

Country _____

McGraw-Hill knows you will be satisfied, but if for some reason you are not, there is a ten-day money-back guarantee that applies on all books. Allow four to six weeks for delivery.

HIGH RELIABILITY

AIRBUS, ARIANE, MIRAGE 2000, METEOSAT, TELECOM 1, TV. SAT, RITA, SHAHINE, CROTALE... Thomson Semiconductors places at your disposal its technical knowledge and experience acquired in these prestigious achievements for the military, aeronautic and space industries and announces conformity of its production with MIL STD 883, class B, revision C.

Linear integrated circuits, microprocessors and peripherals, memories and gate arrays, the Military and Space division of Thomson Semiconductors offers you high performance, high reliability components, using the most advanced technologies (HMOS, 2μ and 1.25μ HCMOS and HBIP) and conforming to international quality standards:

- MIL STD 883 class B, revision C,
- ESA SCC 9000 B or C, LAT 1, 2 or 3,
- CECC 90000 D, G and B,
- UTE NFC 96883 D, G and B.

First European supplier of products in conformity with MIL STD 883, Thomson Semiconductors has highly qualified personnel, trained to implement the rigorous quality control procedures.

The Military and Space Division of Thomson Semiconductors, which groups in the same organization design and production facilities, can be justly proud of being among the best on the market.



THOMSON

SEMICONDUCTORS



France
PARIS VÉLIZY
Tel. (3) 946 97 19

Austria
WIEN
Tel. (222) 94 62 82

Bénélux
BRUXELLES
Tel. (2) 646 64 85

Brazil
SAO PAULO
Tel. (5511) 542 47 22

Canada
MONTREAL
Tel. (514) 288 41 48

Denmark
COPENHAGEN
Tel. (01) 83 50 90

Far East Asia
HONG KONG
Tel. (3) 721 95 82

Finland
HELSINKI
Tel. (0) 7

A NEW HORIZON

MIL STD 883 FROM EUROPE

A SERVICE ADAPTED TO YOUR NEEDS

- Thomson Semiconductors can meet the particular "engineering" requirements of its professional customers (quality level, packaging, qualification, acceptance tests, CAD assistance, temperature range).
- Thomson Semiconductors handles requests and products in high security installations ensuring secrecy of projects.
- Thomson Semiconductors continuously support an "upgrading" policy of all its product ranges to Military standards, (graphic processors, modems, memories, etc.).

A WIDE RANGE OF PRODUCTS AVAILABLE IN A SELECTION OF PACKAGES

- Linear integrated circuits,
- Microprocessors and peripherals,
- Memories,
- Gate arrays.

• LINEAR INTEGRATED CIRCUITS

FUNCTION	USE	TECHNOLOGY	
		BIPOLAR	BIFET/CMOS
OPERATIONAL AMPLIFIERS	General purpose	UA 709-UA 741	BIFET LM 351-LM 353 TL 081-TL 082 TL 084
	Precision	LM 101-LM 101 A LM 11	TL 071-TL 072 TL 074
	Low noise	LM 108-LM 108 A	TL 061-TL 062 TL 064
	Low consumption	LM 124	
	Single voltage Low bias current	LM 158-LM 134	LF 155-LF 156 LF 157
VOLTAGE REGULATORS	Fixed negative output positive output	UA 79XX series LM 123 UA 78XX series	
	Adjustable negative output positive output	LM 137 LM 105-LM 117 LM 138	
VIDEO CONVERTERS	6 bits-Flash A/D 8 bits-Flash A/D 8 bits-D/A		CMOS TS 8306 TS 8308 TS 8408
F/V AND V/F CONVERTERS	A/D high speed 4 bits Voltage-Frequency	UAC 1005 LM 131	
SAMPLE AND HOLD	Precision: 12 bits		BIFET LF 198
ACTIVE FILTERS	Low pass, high pass and band pass. Butterworth, Cauer Tchebycheff. 3 to 8 poles		CMOS TS 85XX series
TIMERS	High stability Adjustable	SE 555 SE 556	

• MICROPROCESSORS AND PERIPHERALS

PRODUCT REFERENCE	Speed MHz	- 40, + 85 °C		- 55, + 125 °C		MIL STD 883			
		Cerdip	Ceramic	Cerdip	Ceramic	LCC	PGA	Cerdip	Ceramic
6800 family (1)	1	•	•	•	•	•	•	•	•
68A00 family (2)	1.5	•	•						
TS 68HC05E2	•	•							
TS 68000	8	•	•	•	•	•	•	•	•
TS 68000	10	•	•	•	•	•	•	•	•
TS 68000	12	•	•	•	•	•	•	•	•
TS 68008	8	•	•	•	•	•	•	•	•
TS 68008	10	•	•	•	•	•	•	•	•
TS 68230	8	•	•	•	•	•	•	•	•
TS 68230	10	•	•	•	•	•	•	•	•
2900 family (3)									
TS 4442									
TS 29747									

(1) includes the TS 6800, 6802, 6803, 6803-1, 6809, 6809-E, 6810, 6821, 6840, 6850, 6852, 6854.

(2) includes the TS 68A00, 68A02, 68A09, 68A10, 68A21, 68A40, 68A50, 68A52, 68A54.

(3) includes the TS 2901B, 2901C, 2902A, 2909A, 2910, 2911A, 2914, 2915A, 2917A, 2918, 2919.

• MEMORIES

PRODUCT REFERENCE		Access time (ns)	CASE				MIL STD 883
			Cerdip	Ceramic	LCC	Slim Line	
Bipolar PROM							
TS 71191	2 K x 8	80	●	●	●		●
TS 71191 A	2 K x 8	60	●	●	●		●
TS 71191 B	2 K x 8	45	●	●	●	●	●
TS 71191 C	2 K x 8	35	●	●	●		●
C.MOS EPROM							
TS 27 C 16	2 K x 8	450	●				●
TS 27 C 32	4 K x 8	450	●				●

• GATE ARRAYS

PRODUCT REFERENCE	Number of elements	Maximum frequency (MHz)
Bipolar Analog		
EFZA	425	500
EFZG	839	500
Bipolar Digital (ECL)		
EFZL	1200	200
EFZM	1700	200
HC MOS Technology		
EFGG	300	35
EFZH	650	35
EFZJ	1000	35
EFZK	1500	35
High Speed HC MOS Technology		
2 metal layers		
EFGL	1400	50
EFGM	2000	50

THOMSON SEMICONDUCTORS Sales Headquarters 45 avenue de l'Europe - 78140 PARIS-VÉLIZY-FRANCE - Tél. (3) 946.97.19.

Italy
MILANO
Tel. (2) 699.41.41
ROMA
Tel. (6) 639.02.48

Japan
TOKYO
Tel. (3) 264.63.48

Norway
OSLO
Tel. (02) 16.16.10

South East Asia
SINGAPORE
Tel. (65) 295.31.24

Spain
MADRID
Tel. 405.16.15
BARCELONA
Tel. (3) 373.30.11

Sweden
STOCKHOLM
Tel. (08) 63.50.60

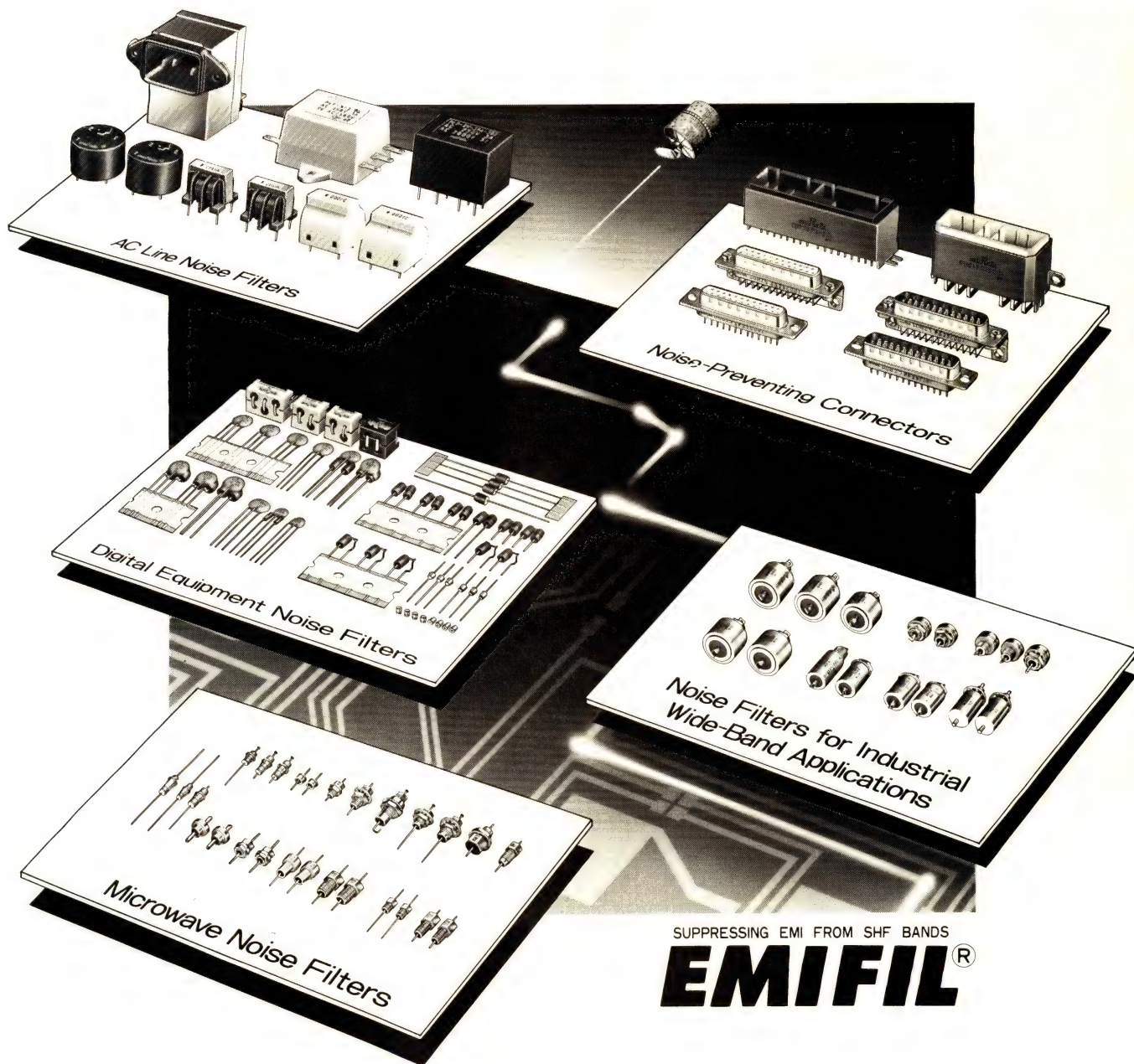
Switzerland
LIEBEFELD/BERN
Tel. (31) 59.22.22

United Kingdom and Ireland
BASINGSTOKE
Tel. (256) 29.155

U.S.A.
RUTHERFORD - NEW JERSEY
Tel. (201) 438.23.00

COMMUNICATIONS WITHOUT NOISE!

Say goodbye to EMI noise, radiation and other malfunctions with easily-mounted EMI filters from Murata.



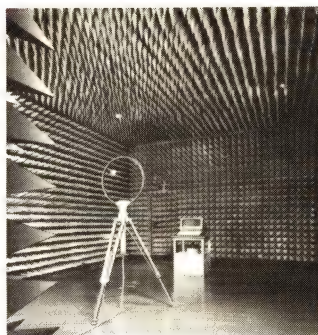
SUPPRESSING EMI FROM SHF BANDS

EMIFIL®

Noise, whether external or internal, can cause serious equipment malfunctions—especially in computers. So today, more than ever, countermeasures against this noise are desperately needed.

It is with this in mind that Murata, with its advanced ceramic material and noise-suppression circuit design technologies, has created a series of EMI filters (EMIFIL®). Not only do they meet the need for noise suppression, but because they can be automatically mounted, they keep assembly costs low.

Murata is hard at work researching noise suppression—from the environment around equipment to measuring and reducing the effects of noise.



"Sealed room" for the study of noise suppression measures

muRata **ERIE**

MURATA ERIE NORTH AMERICA, INC.	Phone: 404-953-1799	Telex: 54232
3002 Kingston Court, S.E., Marietta, GA 30067, U.S.A.		
MURATA ERIE ELEKTRONIK GMBH (West Germany)	Phone: 0911-66870	Telex: 62375
Kreuzstr. 1A D-8500 Nürnberg 52, West Germany		
MURATA ERIE ELECTRONIQUE S.A. (France)	Phone: 024-6767	Telex: 69995
MURATA ERIE ELETTRONICA S.R.L. (Italy)	Phone: 585-4833	Telex: 3303
MURATA ERIE ELECTRONICS (UK) LTD. (England)	Phone: 2514-2855	Telex: 8589

muRata
MURATA MFG. CO., LTD.

HEADQUARTERS
26-10, Tenjin-cho, Nagaokakyō, Kyoto 617 Japan Phone: 075-951-9111 Telex: 64270 MURATA

MURATA ELECTRONICS SINGAPORE (PTE.) LTD. (Singapore) Phone: 2554233 Telex: 2115

TAIWAN MURATA ELECTRONICS CO., LTD. (Taiwan) Phone: 042-91-4151 Telex: 1134

(Taipei Office) Phone: 02-562-4218

MURATA COMPANY, LTD. (Hong Kong) Phone: 262099 Telex: 5620

MURATA MFG. CO., LTD. Seoul Branch (Korea) Phone: 720-7605/720-7321 Telex: 2581

FIBER OPTICS

A range of packages with from 28 to 120 pins is available, including leadless chip carriers, DIPs, and pin-grid arrays. Turnaround time for samples is eight weeks, and new codes are now being accepted. Pricing varies according to quantity and complexity of the order.

Advanced Micro Devices Inc., 901 Thompson Pl., P.O. Box 3453, Sunnyvale, Calif. 94088. Phone (408) 732-2400 [Circle 369]

Programmable logic arrays have 32 or 64 product terms

Combining high-performance CMOS technology with field programmability, a family of erasable programmable logic arrays consists of two groups: Group I features 32 product terms and an expander cell with combinational logic outputs, and Group II offers 64 product terms, product-term sharing, combinational logic outputs, and up to eight registers.

Each device contains a programmable AND structure, fixed OR structure, and a programmable output cell. In addition, the low-power units include programmable output polarity and programmable I/O pins, and feature propagation delay of just 55 ns.

Initially the parts will be available in ceramic packages and ceramic packages with quartz lids. High-volume production will begin in the third quarter on versions housed in plastic molded DIPs. Samples are available now; unit pricing begins at \$12.92 for Group I devices, and \$6.31 for Group II devices.

VLSI Technology Inc., 1109 McKay Dr., San Jose, Calif. 95131.

Phone (408) 942-1810 [Circle 368]

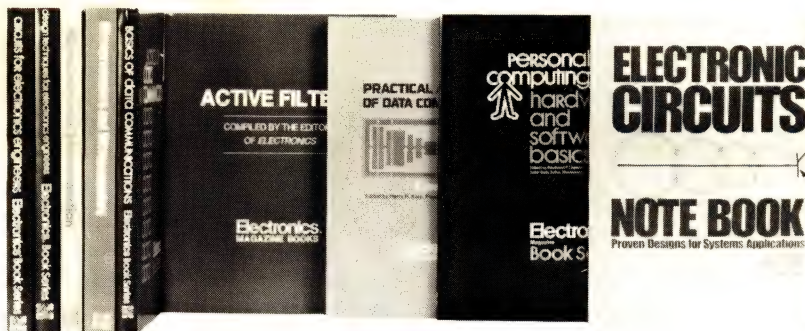
Module converts video signal for optical transmission

Conventional closed-circuit TV cameras can be adapted for use with fiber optics with the XV-1050 fiber-optic video transmitter module. When mounted in the space normally used by a common SO-239 ultrahigh-frequency-type connector, the XV-1050 converts a composite 1-V point-to-point video signal (75- Ω) to linear modulated light for transmission on fiber-optic cable with a 50- or 100- μ m core. Distances of over three miles can be covered without using boosters, equalizers, or repeaters with this system, the manufacturer says.

The XV-1050 operates from a 12-V dc power supply at 40 mA (average). The module can be installed by means of a subminiature type-A optical connector and solder/push-on connector pins, and it can be adapted to retrofits or updates. Operating over the 10-Hz-to-10-MHz video bandwidth on a wavelength of 820

Published by Electronics Magazine...

Books of special interest to our readers



Circuits for Electronics Engineers

Almost 350 diagrammed circuits arranged by 51 of the most useful functions for designers. Taken from the popular "Designer's Casebook" of *Electronics*, these circuits have been designed by engineers for the achievement of specific engineering objectives. Pub. 1977, 396 pages, softcover. Order No. R-711, \$17.95.

Electronic Circuits Notebook

Contains 268 completely illustrated electronic circuits conveniently arranged by 39 vital functions, including amplifiers, audio circuits, control circuits, detectors, converters, display circuits, power supplies and voltage regulators, function generators, memory circuits, microprocessors, and many others, as published in *Electronics* magazine 1977-1980. Companion volume to *Circuits for Electronics Engineers*. Pub. 1981, 344 pages, softcover. Order No. R-026, \$17.95.

Design Techniques for Electronics Engineers

Expert guidance at every point in the development of an engineering project—making measurements, interpreting data, making calculations, choosing materials, controlling environment, laying out and purchasing components, and interconnecting them swiftly and accurately. Nearly 300 articles from *Electronics*' "Engineer's Notebook," with more than 500 diagrams and tables. Pub. 1977, 370 pages, softcover. Order No. R-726, \$17.95.

Microelectronics Interconnection and Packaging

Articles from *Electronics* include sections on lithography and processing for integrated circuits, thick- and thin-film hybrids, printed-circuit-board technology, automatic wiring technology, IC packages and connectors, environmental factors affecting interconnections and packages, computer-aided design, and automatic testing. Pub. 1980, 321 pages, softcover. Order No. R-927, \$15.95.

Microprocessors and Microcomputers:

One-chip Controllers to High-end Systems

Practical orientation to all aspects of microprocessors and microcomputers in 95 articles from *Electronics* covering low-end microcontrollers, mid-range microprocessors, high-performance 16-bit microprocessors, high-speed bipolar processors, peripheral support chips, signal processors, board-level microcomputers, software and applications. Pub. 1980, 482 pages, softcover. Order No. R-011, \$18.95.

Basics of Data Communications

This compilation of essential articles from *Data Communications* magazine includes chapters on terminals, acoustic couplers and modems, communications processors, networking, channel performance, data link controls, network diagnostics, interfaces, and regulations and policy. Pub. 1976, 303 pages, softcover. Order No. R-608, \$15.95.

Practical Applications of Data Communications

Selected articles from *Data Communications* magazine cover architecture and protocols, data-link performance, distributed data processing, software, data security, testing and diagnostics, communications processors, and digitized-voice and data-plus-voice. Pub. 1980, 424 pages, softcover. Order No. R-005, \$17.95.

Personal Computing: Hardware and Software Basics

More than 50 articles from leading publications provide information on personal computing hardware, software, theory and applications. Pub. 1979, 266 pages, softcover. Order No. R-903, \$15.95.

Active Filters

Covers the theory and practical implementation of filter networks built with active elements. Includes design tables and computer/calculator programs, as published in *Electronics*. Pub. 1980, 133 pages, softcover. Order No. R-003, \$11.95.

Order today using this coupon!

Electronics Magazine Books

P.O. Box 541
Hightstown, NJ 08520
609/426-5070

McGraw-Hill Intl. Publications Co.
European Circulation Center
Maidenhead, Berks. SL6 2QL, UK
(Tel. 0628) 23431; Telex 848640)

Order #	Qty	Price
R-_____	_____	\$ _____
R-_____	_____	\$ _____
R-_____	_____	\$ _____
R-_____	_____	\$ _____
R-_____	_____	\$ _____

Name _____

Title _____

Company _____

Street/PO address _____

City/State/Zip (Outside USA: City/postal code/country) _____

☐ Payment enclosed (Payment must accompany orders under \$25. USA residents add applicable local tax.)
☐ Bill my company (or attach company Purchase Order)
☐ Bill me

Ten-day money-back guarantee applies on all books.



nm, the transmitter features a signal-to-noise ratio of 60 dB (typical). Optical power output (100 μ m) is rated at 20 μ W (typical).

In production quantities, the XV-1050 is priced under \$50. Delivery time is based on the size of the order.

Math Associates Inc., 2200 Shames Dr., Westbury, N.Y. 11590.
Phone (516) 334-6800 [Circle 354]

Coupler's star shape distributes one signal to multiple channels

Over the Star Coupler, optical signals from a single input source are distributed to multiple output channels. Transmissive and reflective Star Couplers are available, both of which use the mixer-rod principle to achieve uniform output levels from each port.

The transmissive coupler operates at optical wavelengths from 600 to 1,600 nm with 100/140- μ m or 50/125- μ m fiber. The insertion loss of 8 by 8 and 16 by 16 transmissive stars (when using pigtail connectors) is 12.5 ± 0.7 dB, and 18.5 ± 1.0 dB, respectively. Pigtail, subminiature type-A, or DIN connectors are available; the manufacturer will quote price and delivery time according to the desired configuration.

Siecor Corp., 489 Siecor Park, Hickory, N.C. 28603.
Phone (704) 327-5000 [Circle 353]

Laser diode braves solder-attachment test

Coupling a minimum of 500 μ W into single-mode fiber, this InGaAsP laser diode boasts a proprietary fiber-metallization process: by metallizing the fiber-optic pigtail, the fiber may be attached using a high-temperature solder rather than epoxy. This all-solder interior package style offers improved reliability, the manufacturer says, as well as good coupling stability over time and temperature.

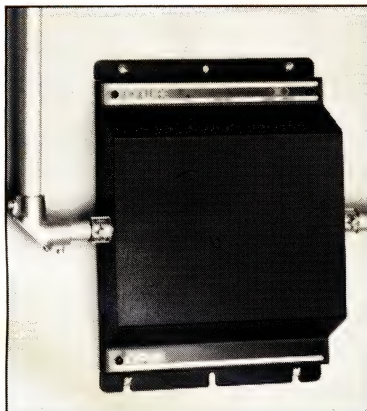
The emission wavelength of the component, model LDT-60009, is 1,300 nm, and it has a typical threshold current of 35 mA. Units are housed in hermetically sealed, 14-pin DIPs with a thermoelectric cooler, thermistor, and a monitor photodetector. In quantity, the LDT-60009 laser diode is priced at \$1,500, and delivery takes four weeks after receipt of order.

M/A-Com Laser Diode Inc., 1130 Somerset St., New Brunswick, N.J. 08901. Phone (201) 249-7000 [Circle 355]

Data-communications net transmits despite noise

Designed to network industrial devices to host computers over existing power-distribution wiring up to 480 V ac, this full-duplex multidrop network joins systems that are compatible with RS-232-C or RS-422-A interfaces. The network's protocol allows a host computer to broadcast to or poll up to 255 bus bars, moving vehicles, and power pickup systems with compatible ports. Units may be up to 3,000 ft apart.

The network conforms to Federal Communications Commission Class A requirements for both conducted and radiated radio-frequency interference, and it is approved by Underwriters Labora-



tories as well. Point-to-point, modem-only units are available, as well as software that is compatible with IBM Corp. Personal Computers for instant on-line use.

The manufacturer will quote price and delivery according to desired configuration.

Cyplex, 4 Kidder Rd., Chelmsford, Mass. 01824.
Phone (617) 256-1918 [Circle 347]

Multiplexer permits devices with different speeds to chat

Multiple phone lines and modems are eliminated by the TX7, a point-to-point statistical multiplexer that compresses onto one phone line the data from up to seven devices. The multiplexer allows all seven to communicate simultaneously at selectable rates from 50 to 9,600 bits per second.

Port-to-port speed conversion means that devices operating at different speeds and setup parameters can communicate. Menus allow each user port to be individually programmed to match the setup parameters of the attached device, and all parameters are then stored in nonvolatile RAM as a precaution against a power failure.

The DT7's DTE (data terminal equipment) port (composite link) uses any full-duplex synchronous modem. The communications-link protocol is X.25 level 2. Systems are available now; prices are quoted according to user configuration.

Complex Systems Inc., 4930 Research Dr., Huntsville, Ala. 35805. Phone (205) 830-4310 [Circle 346]

Work station's gridless router avoids constricting layouts

The Boardmaster design system, a work station for the design and layout of pc boards, performs schematic entry, logic simulation, timing verification, and automatic placement and routing. Featuring a gridless router that the company says speeds the layout process and improves the ease with which they can be manufactured, the Boardmaster also includes general-purpose drafting facilities for creating final manufacturing drawings. The system also automatically extracts logic gates from the schematic and assigns them to IC packages from an approved parts library.

Based on Intel Corp.'s 80286 microprocessor, the Boardmaster system, which marks Daisy's first entry into the design of boards, includes an 80-megabyte hard disk, a 19-in. high-resolution color monitor, and a bit-slice-based graphics accelerator. Available in September, a single-user system is priced at \$110,000.

Daisy Systems Corp., 700 Middlefield Rd., Mountain View, Calif. 94043. Phone (415) 960-0123 [Circle 380]

Automated CAE tool set cuts development time

Billed as the first fully automated set of pc-board design tools to be integrated into a computer-aided engineering environment, Board Station from Mentor Graphics Corp., uses proprietary automatic-placement-and-routing algorithms and a complete set of interactive layout editing tools to cut development time of pc boards by up to 75%, according to the manufacturer.

The system, built around Apollo Computer Corp.'s work station, handles thin- and thick-film hybrids, surface-mounted devices, and partitioning with a pc-board layout design.

Available for delivery in the fourth quarter, the minimally configured Board Station costs \$79,900.

Mentor Graphics Corp., 8500 S.W. Creekside Pl., Beaverton, Ore. 97005. Phone (503) 626-7000 [Circle 381]

Impact-modified nylon-6 in four grades, called Nydur, is finding a wide range of applications in the automotive industry for body parts such as rocker panels, front spoilers, bumpers, flexible fascias—wherever both strength and flexibility are required. Common to all grades is an extremely high impact strength, even at low temperatures, and abrasion resistance.

Mobay Chemical Corp., Mobay Rd., Pittsburgh, Pa. 15205. Phone (412) 777-2495
[Circle reader service number 421]

Structural foam for automobile load floors, glove-box doors, and mass-transit seating has been introduced in three foamable resin grades based on a proprietary technology that eliminates the need for glass nucleating agents, thereby enhancing the surface appearance. Outgassing time is also reduced in this process. The material has high ultraviolet-light and heat resistance, and it survives a 50 ft-lb impact test.

General Electric Co., Plastics Group, Inquiry Handling Service—PR #79/85, 1 Plastics Ave., Pittsfield, Mass. 01201.
Phone (800) 422-1600 [Circle 422]

Paintable in conventional automotive top-coat ovens, Duraloy thermoplastic alloys include impact-modified polyesters developed for automotive bumpers and body panels. Other grades are aimed at extrusion applications, including fuel lines and gear tapes. The alloys are said to exhibit exceptional chemical and impact resistance, and to be ductile even at low temperatures.

Celanese Engineering Resins, 26 Main St., Chatham, N.J. 07928.
Phone (201) 635-4314 [Circle 423]

Silicone additives and silicone resins that form thermoset coatings, either as pure silicone vehicles or as blends with organic polymers, are offered in a number of formulations. All are said to feature high heat hardness, long-term heat resistance, weather and ultraviolet-light resistance, and flexibility. For the designer, these silicone materials bridge the gap between conventional organic finishes and vitreous enamels.

General Electric Co., Silicone Products Division, Waterford, N.Y. 12188.
Phone (518) 266-3505 [Circle 424]

Battery-powered, the BJW-3 daisy-chain wire-wrapping tool allows the user to wrap directly from a wire reel or spool without precutting and prestripping. Thus, continuous strings can be wired across any number of points with a single insulated wire. The tool comes with a bit and sleeve and a 100-ft spool of 30 AWG wire (refill spools are avail-



able); batteries are not included.

Davle Tech Inc., 2-05 Banta Pl., Fair Lawn, N.J. 07410.
Phone (201) 796-1720 [Circle 425]

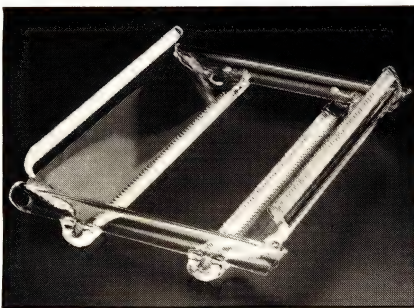
Unpigmented natural Kynar, formulated from polyvinylidene fluoride (PVDF)—one of the most chemically inactive engineering plastics—finds numerous applications in the fluid-handling systems of the semiconductor industry. The plastic is available in custom tubes, films, sheets, fabric-backed sheets, and in other shapes and a variety of thicknesses for fabrication to the customer's requirements.

Wright Associates Inc., P.O. Box 719, Valley Forge, Pa. 19481.
Phone (215) 783-7970 [Circle 426]

White, cream, reddish-brown, and black are the colors available in high-temperature marking kit No. 608, consisting of inorganic inks for use at temperatures to 3,000°F. The inks will mark ceramic, glass, stainless steel, aluminum, and graphite. After being cured at 200°F, they are ready for high-temperature use.

Aremco Products Inc., P.O. Box 429, Ossining, N.Y. 10562.
Phone (914) 762-0685 [Circle 427]

Quartz profile tubing and minimal welds for maximum structural integrity are the boast of this high-temperature wafer carrier, available for 4-, 5-, 6-, and 8-in. wafers. The carrier operates at temperatures of 1,280°C. The manufac-



turer says that the wafer carrier is adaptable to most automatic wafer-transfer systems, including their own suspended loading system series.

Heraeus Amersil Inc., 650 Jernees Mill Rd., Sayreville, N.J. 08872.
Phone (201) 254-2500 [Circle 430]

A one-component silver-filled epoxy adhesive, Tra-Duct 2971 is recommended by the manufacturer for microcircuits, lead terminations, and other pc-bonding and -shielding applications. It bonds to ceramics, most metals, glass, and many plastics. Outgassing is low, and after a cure schedule of 30 min at 150°C, the adhesive offers a volume resistivity of 0.0005 Ω -cm.

Tra-Con Inc., Resin Systems Division, 55 North St., Medford, Mass. 02155.
Phone (617) 391-5550 [Circle 428]

Wafer dicing and die-attach operations are targeted by Sta-film, a semicured die-bonding adhesive laminated to a carrier film. Sta-film eliminates dispensed liquid adhesives from the dicing process and simplifies automation by integrating dicing and die-attach operations. It is compatible with conventional assembly equipment and methods, the manufacturer says, and is available for hermetic or plastic packages.

Stauffer Chemical Electronic Technologies, 1195 W. Fremont Ave., Sunnyvale, Calif. 94086.
Phone (408) 773-2615 [Circle 429]

Fans in industry-standard frame sizes and with air flows of 4 to 250 ft³/min, the Flowmax line is offered for personal computers, disk drives, word processors, medical equipment, and flight instrumentation. These ac and dc axial-motor fans are available in standard, low-speed, and ultralow-speed models and in all voltages. The life rating is 50,000 h. Units meet Underwriters Laboratories, Canadian Standards Association, and other standards.

NMB Corp., 9730 Independence Ave., Chatsworth, Calif. 91311.
Phone (818) 341-0820 [Circle 431]

Data-transmission cables with multi-pair configuration, manufactured from fluoropolymer materials, the Datacom line is available in either standard or low-capacitance ratings and in either 24- or 22-AWG sizes. Datacom cables come with either an overall aluminum polyester tape shield and drain wire or with individual shielding and drain wire for each pair of conductors. They are accepted for plenum installation without conduit.

Habia Cable Inc., 2150 Fifth Ave., Ronkonkoma, N.Y. 11779.
Phone (516) 588-0200 [Circle 432]

Electronics July 22 issue

For
Space Reservations
Call: Production Department
(212) 512-3140

Applications-Specific ICs

Individually designed chips promise to affect every level of the product creation process—from parts purchasing to marketing and sales. This Electronics Week report zeroes in on new technologies and configuration trends, and projects the prospects for

techniques still on the drawing board.

The Market

An estimated 50% of the \$70 billion total IC market by 1990.

Target Readers

Device designers, systems makers, product planners, and virtually all management in electronics.

Issue Date:
July 22, 1985

Closing for Advertising:
July 1, 1985



Electronics
Influence Beyond Design

Electronics July 29 issue

For
Space Reservations
Call: Production Department
(212) 512-3140

Special Issue: Computer-Aided Engineering

Low-cost 32-bit engineering workstations with 32-bit architectures and high-performance graphics are looming on the horizon. This Special Report covers the next generation of workstations, plus new trends in graphics, processor, and software technology.

The Market

\$200 million in 1984, \$350 million in 1985—and \$1.2 billion expected by 1988.

Target Readers

Engineering managers and technically trained corporate managers, printed circuit board and integrated circuit designers.

Issue Date:
July 29, 1985

Closing for Advertising:
July 8, 1985



Electronics
Influence Beyond Design

LETTERS

Bellcore volunteers

To the editor: In reference to your article on Bell Communications Research [*ElectronicsWeek*, March 11, 1985, p. 28], it should be emphasized that Bellcore was created at their option by the seven regional companies formed at the breakup of the Bell System, not by the U.S. District Court as indicated by the information from Edward Diamond. Each function was placed in Bellcore by us to fill a specific need.

A.V. Smith, President
Pacific Northwest Bell
Seattle

Du Pont clarification

To the Editor: You inaccurately termed Freon a hydrocarbon and highly toxic solvent in a recent article [*ElectronicsWeek*, March 18, 1985, p. 38].

Freon is Du Pont's registered trademark for various chlorofluorocarbons (CFCs) including Freon TF or CFC-113, which is a solvent used by the electronics industry. The use of Freon as a generic term in the article is a misuse of our valued trademark. Furthermore, the Freon solvents are not hydrocarbons. Hydrocarbons are composed of the elements carbon and hydrogen while Freon TF contains carbon, chlorine, and fluorine. An important difference is that hydrocarbon solvents are flammable, CFC-113 is not. In addition, CFC-113 has the lowest toxicity accorded to any compound except carbon dioxide and simple asphyxiants, such as nitrogen.

Richard B. Ward
E.I. du Pont de Nemours & Co.
Wilmington, Del.

No small fry

To the editor: In your article on computer-aided design [*ElectronicsWeek*, Feb. 18, 1985, p. 38], it is amusing to be called a "small firm." We have sold more CAD packages than Super-Compact [computer-aided-engineering software package from Compact Software Inc.] and Eesof Inc. [a vendor of CAE/CAD software] combined, and our dollar sales volume is larger than Eesof's.

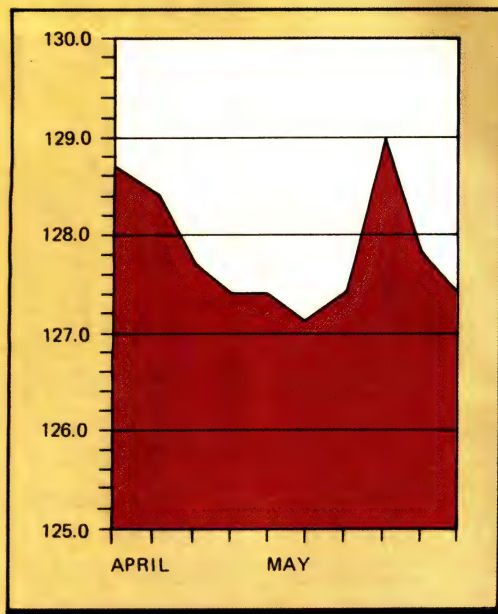
Ulrich L. Rohde, President
Communications Consulting Corp.
Upper Saddle River, N.J.

Corrections

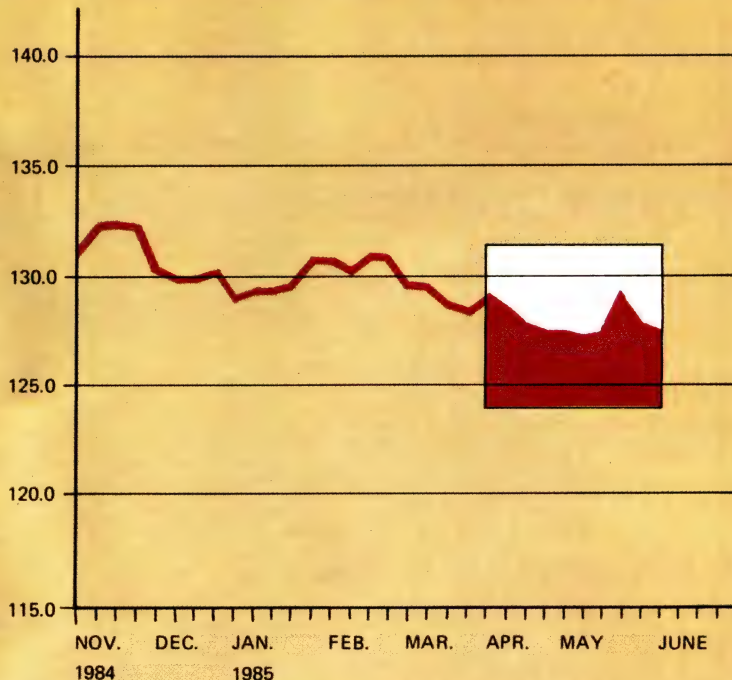
In *ElectronicsWeek*, May 13, 1985, p. 69, the price of the STD-202 Commander single-board computer was given as \$395. The correct price is \$595.

In *ElectronicsWeek*, May 27, p. 79, the note on Digital Audio Signal Processing omitted the book's price. It is \$34.95.

ELECTRONICS INDEX



THIS WEEK = 127.4
 LAST WEEK = 127.8
 YEAR AGO = 106.2
 1982 = 100.0



The *ElectronicsWeek* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U.S. GENERAL ECONOMIC INDICATORS

	April 1985	March 1985	April 1984
Average prime rate (%)	10.50	10.50	11.93
Retail sales (\$ billions)	112.225	111.096	107.443
Unemployment rate (%)	7.2	7.3	7.7

U.S. ELECTRONICS INDUSTRY EMPLOYMENT

	April 1985	March 1985	April 1984
Production workers (thousands)			
Office and computing machines	191.3	187.2	199.8
Communications equipment	295.3	299.8	277.1
Radio and TV receiving equipment	56.3	58.0	61.8
Components	386.2	401.6	408.0

Further deterioration in the employment of production workers in the electronics industry was a major contributor to a decline in the *Electronics* Index of 0.3% in the latest week. With the biggest corporate names in the electronics industry announcing plant closings and worker layoffs, electronics employment in April—the latest month for which statistics are available—went down practically across the board.

Computer companies made the only employment gains, increasing their work force 2.3%. The components industry suffered the biggest loss in employment—3.8% of its work force. Nearly as severe was the 2.8% drop in labor ranks among TV and radio-equipment manufacturers, according to the government data. Though the 1.5% drop in employ-

ment at communications-equipment companies seems almost benign in comparison, April marked the first time in recent months that this segment of the industry suffered any employment declines at all.

The precipitous drop in overall demand for electronics equipment in the U.S. is the main reason for the decline in employment in the electronics industry. One contributing factor for the drop in production remains the strong dollar—and the foreign equipment producers thriving in U.S. markets because of it. In recent months, despite slipping interest rates, the dollar has remained at lofty heights compared with other major currencies around the world. That means that electronics firms will probably continue to trim their payrolls in the months to come.

POSITIONS VACANT

Engineers — Discreet, Personal, Reputable.
National-fee paid. Murkett Assoc., Box 527,
Montgomery, AL 36101.

POSITIONS WANTED

Designing a product? I do electronics/mi-
croprocessor based design and program-
ming. Project rates. Mr. Masel (718) 476-
1516 (NY).

SPECIAL SERVICES

Electronic Product/Black Box Designer —
Microprocessor hardware/software. Rea-
sonable rates. Will consider working at cost
with royalties. T. R. Duprey. (916) 969-7741
Calif.

HOT LINE

To place your
recruitment message
in
Electronics Week

call Pat Clyne

at
212/512-2557

Advertise your software for only \$114.75

For only \$114.75 per inch you can
advertise your software, designed
specifically for the electronics in-
dustry, to a no-waste audience
designed specifically in need of it—Electronics
Week's paid circulation of 102,000
subscribers.

You'll waste no advertising dollars
on waste circulation. These decision-
makers need software applications
designed specifically for their in-
dustry. That's why EWeek's Com-
puter Software Section is a perfect
interface because it is programmed
to connect you with specific industry
interests.

Send your copy/art to the address
below. For more information, call
Patti Clyne at 212/512-2557.

Electronics Week Computer Software Section

Post Office Box 900
New York, NY 10020



1985 ELECTRONICS WEEK COMPUTER SOFTWARE SECTION

Sizes	Material
1 Inch 7/8 x 2 1/4	Artwork or
2 Inch 1 7/8 x 2 1/4	film preferred.
3 Inch 2 7/8 x 2 1/4	Typesetting
4 Inch 3 7/8 x 2 1/4	free of charge.

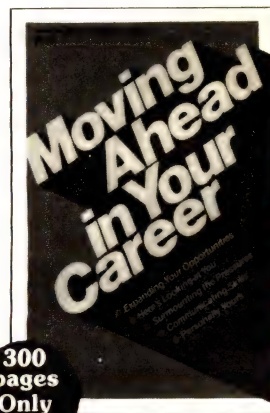
1985 RATES

Unit	1X	6X	12X
1 Inch	\$114.75	\$113.75	\$112.80
2 Inch	229.50	227.50	225.60
3 Inch	344.25	341.25	338.40
4 Inch	459.00	455.00	451.20

Call
Patti Clyne
212/512-2557

Are you in your first engineering job?

Are you thinking about where you go from here?



This book is a practical how-to-do-it
guide from Graduating Engineer that
you can put to use right now—articles
like "How to Get a Good Performance
Appraisal", "The Importance of a Men-
tor", "The Road to \$50,000 a Year",
"Winning at Office Politics"—and many
more. Send for this book today and
begin to move ahead in *your* career.

GRADUATING ENGINEER
P.O. Box 900
New York, NY 10020



Please send me ___ copies of "Moving
Ahead in Your Career" at \$9.95 each.
Enclosed is my check/money order
made out to Graduating Engineer for
\$_____

Name _____

Address _____

City/State/Zip _____

E

AVAILABLE!

1985-86 Electronics Buyers' Guide



Order your copy today for
the industry's most often-
used directory:

- It's three directories in one
- Includes more than 4,000 product listings (approx. 700 pages)
- Contains over 5,000 company listings (approx. 400 pages) including:
 - Company name, address and phone number.
 - Name and title of contact for sales information.
 - Number of engineers at plant and number of employees.
 - Annual dollar sales volume.
 - Local sales offices and manufacturers representatives.
 - Local distributors.
 - Instant referral to company's advertisements.
- Offers FREE current catalog retrieval service (approx. 1300 catalogs)

Price: \$40 USA & Canada
\$50 elsewhere
(add \$30 for airmail)

Send order with payment to:

Regina Hera

Electronics Buyers' Guide

1221 Avenue of the Americas

New York, NY 10020



Advertisers Index

Amkor Electronics Inc.	3
Anritsu Electric Company	10-11
AT & T Communications	65
AT & T Information Systems	37
† AVX	5
† Barbados Industrial Development Corp.	69
■ Basler Electric	53
Compaq	40-41
CTS Corporation	46
Futurenet	2nd C
Hewlett-Packard Company	1
Hughes Aircraft	25
* I.P.M.S.p.A.	7
ITT Standard AG	67
■ Kepco Incorporated	4th C
■ Mabuchi Motor America Corp.	53
† Maryland Department of Econ. & Comm. Dev.	58
* Matsuo Electric Co.	4E
■ 3M Commercial Office Supply	15
■ Murata Manufacturing Co.	8E
National Semiconductor	26-27
NEC Corporation	9
* Olivetti, ING. C., & C.	5
* Phillips Elcoma	58
* Rohde & Schwarz	1E
Sharp Corporation	16
† Siemens Corp./Special Products Division	7
SimuTec	12
Technipower A Penril Co.	67
Texas Instruments	3rd C
Therm-O-Disc, Inc.	63
* Thomson Semiconductor	2E-3E, 6E-7E
TWA	45
United States Postal Service-Zip+4	30
Zehntel Incorporated	38-39

Classified and employment advertising

Hayes Microcomputer Products, Inc. 29

■ For more information of complete product line see advertisement in the latest Electronics Buyers Guide

* Advertisers in International edition

† Advertisers in domestic edition

Advertising Sales Staff

Atlanta, Ga. 30319: Joseph Milroy
4170 Ashford-Dunwoody Road N.E.

[404] 252-0626

Boston, Mass. 02116:

Joanna Henderson

575 Boylston St.

[617] 262-1160

Chicago, Ill. 60611

[312] 751-3738

645 North Michigan Avenue

Cleveland, Ohio 44113: Joe Milroy

[215] 496-3800

Costa Mesa, Calif. 92626: Debbie Smith

3001 Red Hill Ave. Bldg. #1 Suite 222

[714] 557-6292

Dallas, Texas 75240: Harry B. Doyle, Jr.

5151 Belt Line Road, Suite 907

[214] 458-2400

Englewood, Co. 80112: Harry B. Doyle, Jr.

7400 South Alton Court Suite 111

[303] 740-4633

Houston, Texas 77040: Harry B. Doyle, Jr.

7600 West Tidwell, Suite 500

[713] 462-0757

Los Angeles, Calif. 90010: Chuck Crowe

3333 Wilshire Blvd.

[213] 480-5210

New York, N.Y. 10020

Matthew T. Reseska [212] 512-3617

1221 Avenue of the Americas

Stamford, Ct. 06902

Albert J. Liedel

777 Long Ridge Road. Bldg. A

[203] 968-7115

Palo Alto, Calif. 94303:

Larry Goldstein, Lauren Scott, Lynne Simonfy

1000 Elwell Court, [415] 968-0280

Philadelphia, Pa. 19102: Joseph Milroy

Three Parkway, [215] 496-3800

Pittsburgh, Pa. 15222: Joseph Milroy

Suite 215, 6 Gateway Center, [215] 496-3800

Southfield, Michigan 48075:

4000 Town Center, Suite 770, Tower 2

[313] 352-9760

San Francisco, Calif. 94111:

Larry Goldstein, Lauren Scott, Lynne Simonfy

425 Battery Street

[415] 362-4600

Brussels: Art Scheffer

23 Chaussee de Wavre

Brussels 1040, Belgium

Tel: 513-73-95

Frankfurt/Main: Fritz Krusebecker, Dieter Rothenbach

19 Liebigstrasse, Germany

Tel: 72-01-81

Milan: Savio Pesavento

1 via Baracchini, Italy

Tel: 86-90-656

Paris: Jean - Christian Acis

17 Rue-Georges Bizet, 75116 Paris, France

Tel: 720-33-42

Scandinavia: Andrew Karnig

Finnbodavagen

S-131 31 Nacka

Sweden

Tel. 46-8-440005

Telex: 17951 AKA S

Tokyo: Hirokazu Morita

McGraw-Hill Publications Overseas Corporation,

Kasumigaseki Building 2-5, 3-chome,

Kasumigaseki, Chiyoda-Ku, Tokyo, Japan

[581] 9811

United Kingdom: Art Scheffer

34 Dover Street, London W1

Tel: 01-493-1451

Business Department

Frederick J. Kostbar

Business Manager/Controller

[212] 512-2627

Leon Irgang

Circulation Director

[609] 426-5542

Archie Anderson

Director of Marketing Services

[212] 512-6642

Frances M. Vallone

Reader Service Manager

[212] 512-6058

Thomas M. Egan

Production Director

[212] 512-3140

Carol Gallagher

Production Manager

[212] 512-2045

Betty Preis

Production Manager

[212] 512-2908

Classified and Employment Advertising

[212] 512-2556

EDITORIAL

What *Electronics* aims to be...

A leading U.S. electronics manufacturer once ran an in-depth survey of information demands among its customers and found their biggest need was "keeping up with technology." And their biggest problem was "not enough time to read." Because of 60-hour-a-week schedules, most executives said they depended primarily on publications, rather than visits to vendors or attendance at classes, seminars, conferences, and trade shows, to find out what the hot topics were. Today, schedules are worse: executives are having more trouble than ever keeping up, and publications play a larger role in keeping them current with the exploding world of electronics technologies.

Electronics aims to do that job every Monday for industry leaders. No publication has the experience or the organization to do this critical task better than *Electronics*, the magazine that named the industry. For a half century we have reported the latest technology news and put it into perspective for our readers. Through a depression, three wars, and several booms, this magazine made its reputation as *Electronics*. Frankly, we tossed out something priceless a year ago when we dropped that name in favor of *ElectronicsWeek*. So we're going back to *Electronics*, a name that many of our readers, and even some of our editors, never quite got out of the habit of using.

Never has the worldwide electronics industry needed a weekly technology magazine more than it does now: a publication with a sense of urgency that can quickly put technology and non-technology developments into perspective and tell its readers first of the trends and developments that will affect their jobs, their companies, their products, and the industry. Busy industry executives have far less time for those publications that dump growing mounds of raw information on their readers without adding interpretation and perspective. Readers want to know why a development is important and how it will affect their job and their company. Nevertheless, most publications tend to be conduits for official corporate information, rather than means to assess, interpret, and put industry developments into context.

...and what our readers can expect to gain from it

Our industry is technology driven—no new development or announcement can be understood without first analyzing the underlying technology trends. Yet this is not enough. Executives have to keep up with trends in marketing, geopolitics, manufacturing, and service. No publication can write about the fortunes of a company or a developing market without getting into technology. And it can't report on new technology without also assessing the marketplace.

No one can do it like *Electronics* can, because no publication has our experienced editorial team: aggressive editors stationed around the globe coupled with an experienced group of technical journalists, each an expert in a technology. We aim to be the first publication to routinely point out important industry and technology trends, and do it in a technically meaningful, easy-to-understand, "reader-friendly" manner. We realize a chip designer doesn't always know communications theory and an engineering manager who hasn't designed a product in years sometimes forgets what he learned in school.

And we report on all the news of electronics—not just one market segment. *Electronics* sprawls across many markets—you can't keep up by following what's happening in just a single area. And because this technology is worldwide in scope, you can't keep up either by following only what's happening at home. A product now burning up the Japanese market could be taking its first step toward competing with your product next year in the U.S.

Like the industry we cover, *Electronics* moves fast. We have to be quick with the news. Technology is changing so fast that getting early word to our readers can often mean the difference between success or failure with a job, a product, or an entire company.

—Robert W. Henkel



Every TI calculator comes with one extra number.

1-800-TI-CARES

When you buy a Texas Instruments calculator you don't just buy a calculator, you buy Texas Instruments' commitment to quality.

It's a commitment backed by a fully developed service network that includes the above toll-free number you can call from anywhere in the United States.

If you have any applications,

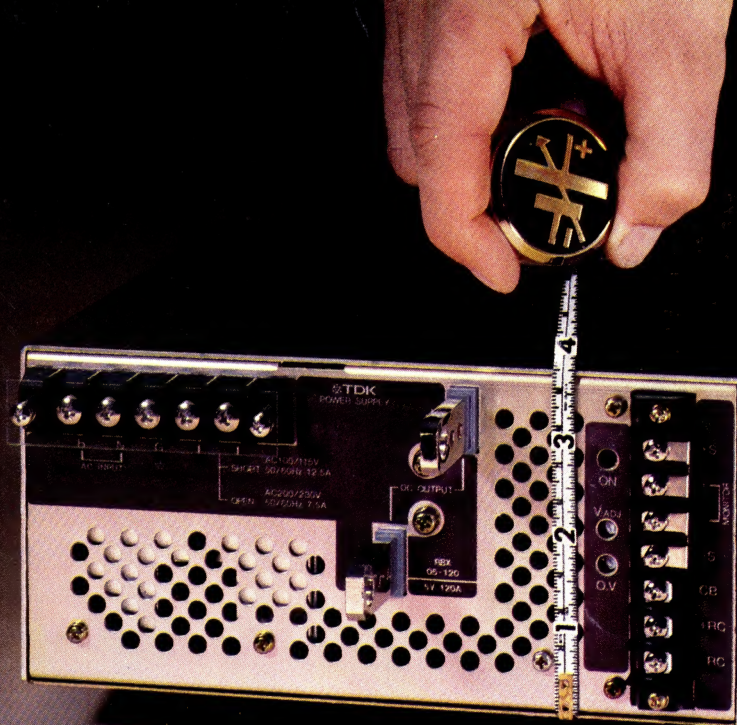
operations, or service questions, call us Monday thru Friday between 9:00 am and 4:00 pm CST, and we'll be glad to help.

If your calculator needs repairing, we'll direct you to one of our 46 conveniently located service centers for an immediate exchange. Under warranty, it's free. If there's no center near you, we'll do it all by mail.

Of course, there's just one catch. It has to be a Texas Instruments calculator. But then, if you're as smart as we think you are, why wouldn't it be?

TEXAS 
INSTRUMENTS

Creating useful products
and services for you.



600 WATTS.

599 DOLLARS.

260 CUBIC INCHES.

New Kepco/TDK 150KHz Switching Power Supply, Series RBX

This brand new product of advanced Kepco/TDK technology squeezes more power into less space at a lower price than you'll find anywhere else today.

It's a highly efficient, FET-based switcher operating at 150KHz.

The Kepco/TDK Series RBX gives you remote on/off, remote voltage control, remote error sensing, adjustable overvoltage protection, adjustable current limiting, an "output OK" LED, 115/230V selectable input, and a current balance circuit which lets you parallel three units and have them share the load.

Model	RBX 02-120	RBX 05-120	RBX 24-25
Volts	2V	5V	24V
Adjustment	1.6-2.2V	4.0-5.5V	19.0-26.5V
Amps	0-120A	0-120A	0-25A
OVP	2.6-2.8V	6.0-6.5V	27-27.5V
Current limit	125-145A	125-145A	26-30A
Efficiency	65%	80%	85%
Dimensions	3 ³ / ₄ " x 7 ⁷ / ₈ " x 8 ¹ / ₁₆ " plus 3 ³ / ₄ " for connectors		

UL Recognition, CSA Certification pending.



KEPCO
THE POWER SUPPLIER™

For complete specifications write Dept. HPF-14

KEPCO INC., 131-38 Sanford Avenue, Flushing, NY 11352 USA • (718) 461-7000 • TWX #710-582-2631 • FAX: (718) 767-1102

Circle 902 on reader service card